For engineers who design and manage the power and plant services

Power

SEPTEMBER 1959

ONE DOLLAR

A McGRAW-HILL PUBLICATION

a *TD* report **Plastics push for piping, valves, fittings ▶65**

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How important is voltage balance? 76

Predicting m-d turbine performance 80

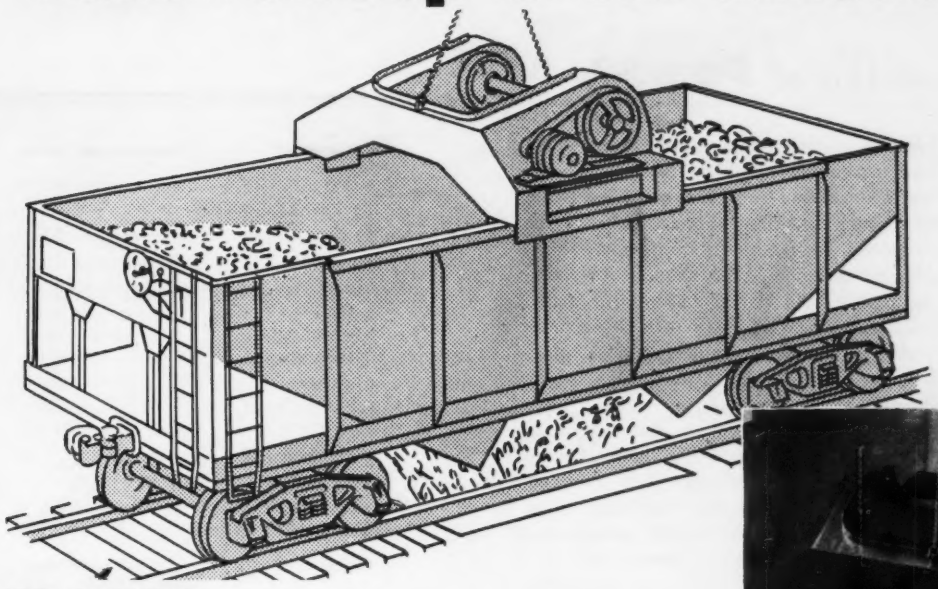
Sure of your diesel timing? 218

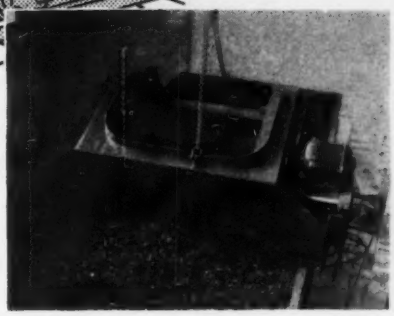
ALLEN-SHERMAN-HOFF

Every day, throughout the world, more than 5,000 valves plus other allied equipment are automatically operated by our Automatic Sequence Controls. We have been supplying complete ash removal systems with varying degrees of job-required automation since 1921. The experience of these years is available upon request. Write, wire or phone THE ALLEN-SHERMAN-HOFF COMPANY, 259 East Lancaster Avenue, Wynnewood, Pa. Cable: Ash-Wynnewood.

For more facts circle 201 on Reader Service card, p 121

Clean sweep in car unloading!





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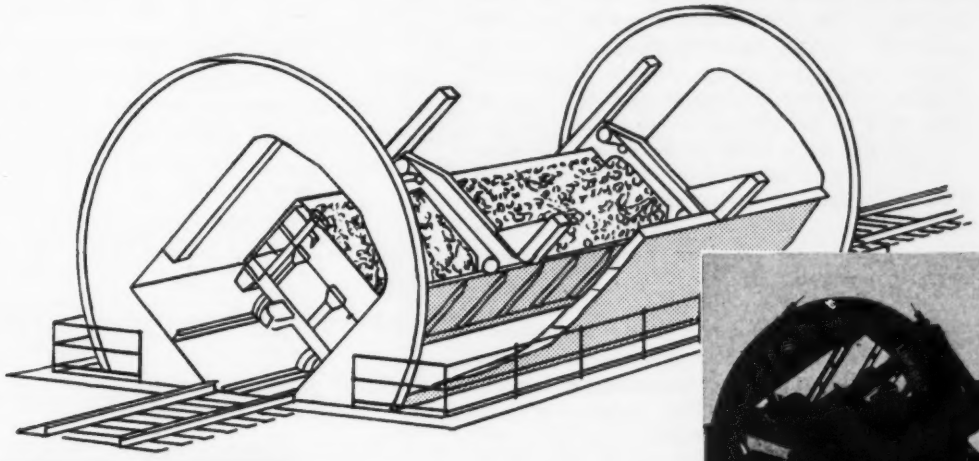
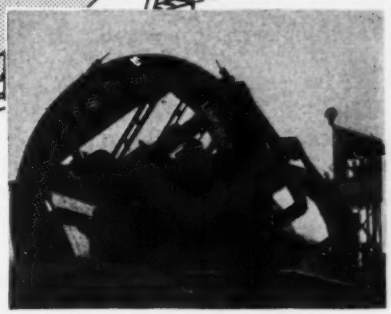
FAIR SHAKE for coal cars. Wear to cars is no more than that encountered in normal operations over road bed. Objectionable noise can be reduced to a minimum. Shaker produces a series of hammer-like blows on the top of the car sides loosening even the hard-packed loads in minutes. Especially good for damp, sticky or frozen loads.





ROTARY DUMPERS

GOOD TURN for large plants. Link-Belt Rotary Dumpers empty a 90-ton gondola car every 45 to 90 seconds (including return to upright position) by simply turning car upside down. Car is securely held in rotating cradle and contents are completely dumped in one operation. Simple, automatic, fool-proof. Takes all open-type cars—any length, width or height.

Only LINK-BELT makes both shakers and dumpers . . . broom-clean unloading for any plant capacity

You can meet any coal unloading need with equipment by Link-Belt. For large operations a Link-Belt Rotary Dumper will unload 20 or more cars per hour. For smaller plants, Link-Belt Car Shakers are available. Both are engineered to do a specific job faster . . . easier . . . at lower cost. Both reduce operational hazards and cut costly demurrage charges.

Call your nearest Link-Belt office. We'll be happy to give you additional facts on Link-Belt Car Shakers and Rotary Dumpers.

LINK-BELT

CAR SHAKERS AND ROTARY DUMPERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,902

For more facts circle 204 on Reader Service card, p 121

speaking of **Power**

Power **editors,** as you might expect, spend much of their time traveling. Within the past few months staffers Ben Skrotzki and Steve Elonka took a swing across the country touching editorial bases in the Pacific northwest and southern California.

Skrotzki attended the AIEE Summer General Meeting in Seattle, then visited major utilities and consultants along the West Coast. On this trip he was particularly interested in spotting nuclear operations. For his findings, see the nuclear roundup in next month's *Plant Design Issue.*

Maintenance was uppermost in Elonka's mind when he visited the small, the large, the well-maintained and the "bailing-wire" plants on the West Coast. Steve came back to the office with some interesting dope on how today's plant maintenance is being handled. You'll find it summarized as a *TD* (Today's Development) report in November.

Side lights noted in the field often prove interesting lunchtime talk among the editors. Assistant Editor Lawson Stewart came across one last month that had its beginning in a New England plant around the turn of the century. Seems the plant engineer at that time laid out an overhead shafting system that is still operating even in the face of modern mechanical power-transmission practice. Reason the scheme persisted through the years reverts back to the original layout which provided one operator for a group of machines. The plant was also blessed with a cadre of old-timers who took an exceptional interest in preventive maintenance. But the end is in sight as new processes bow in and old-timers bow out. For the full power-service story on this plant, see p 83.

Staff promotions are always pleasant to announce. With the leaving of Art Sommer to take an editorial position with *Post Exchange* magazine, Pru Schwabe —a Hunter College Phi Beta Kappa—has been promoted from editorial assistant to assistant editor, taking over the key post on the copy desk.

Lon Lowley

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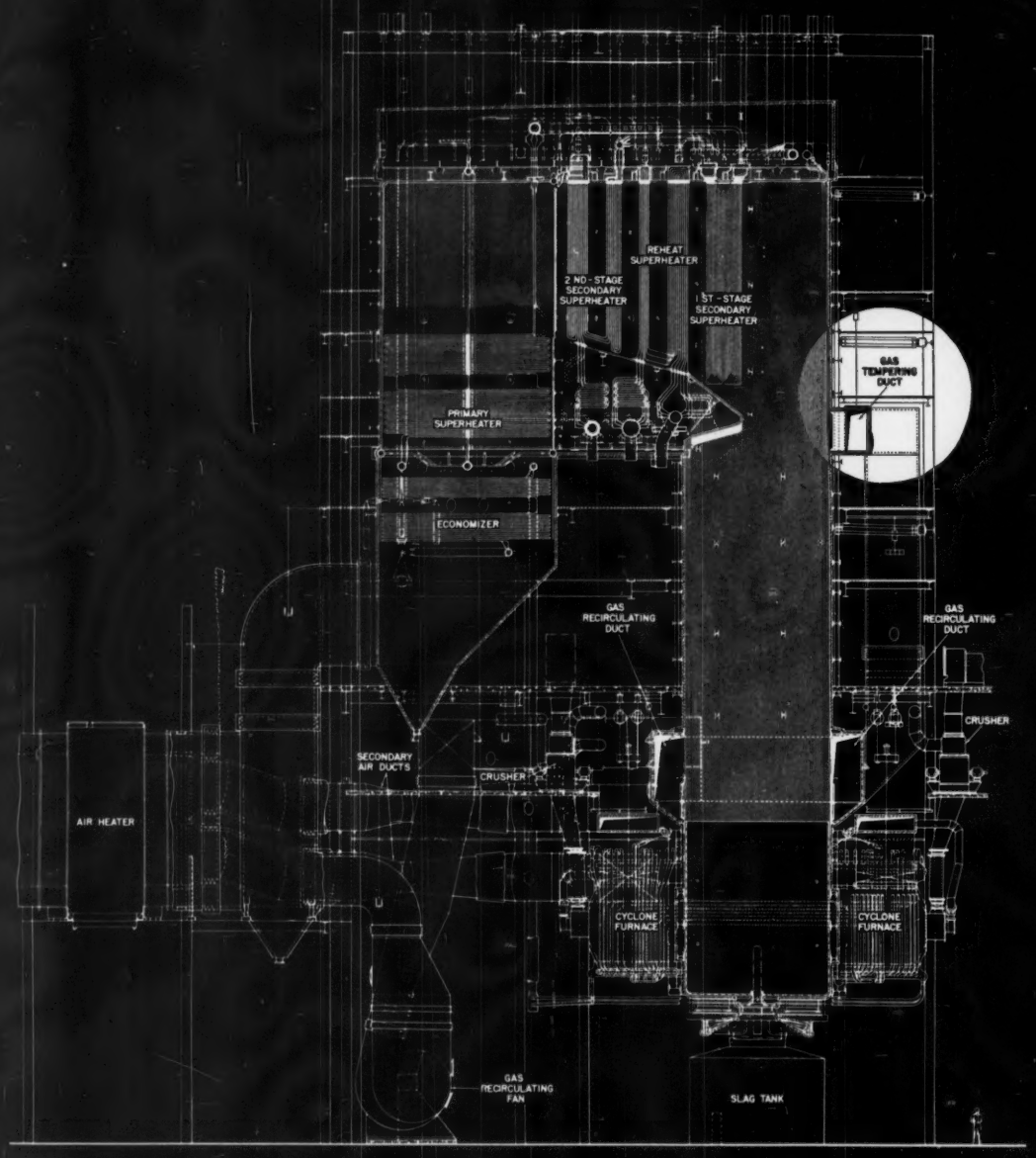
Gas Tempering: **Report No. 2**

Electric Utilities Find Points Way to



B&W Cyclone Furnace Universal Pressure Boiler.
Coal is the primary fuel with oil as an auxiliary fuel.

Gas Tempering Fuel Economies

...Lets You Burn The Most Economical Fuel Available— Coal, Oil or Gas

Gas Tempering—is the reintroduction of cool flue gases near the furnace outlet to control the temperature of the gases entering the convection surface. It is the practical means to help you burn the most economical, most easily available fuel.

Gas Tempering enables you to burn a variety of coals without slagging.

It minimizes external corrosion of superheater tubes. It reduces metal temperature, cuts need for high alloys, prolongs tube life, regardless of the fuel burned.

In effect, gas tempering allows you to adjust the size of your furnace to meet the characteristics of the fuel. This is done by varying the amount of tempering to chill the furnace exit gases to a temperature known to be satisfactory for the fuel burned. The gases are cooled but the total heat available to the superheater remains the same.

That's Why with Gas Tempering, you no longer need to pass up attractively-priced fuels.

Definitive Booklet: If you'd like to learn more about the economies and design flexibility available to you through Gas Tempering, write for Bulletin G-96. Address: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

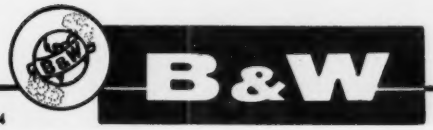
Major Advantages of B&W Gas Tempering

. . . It cuts overall plant costs because the smaller size unit requires a smaller building per kw, a lighter foundation, less structural steel and shorter steam leads.

. . . It enables you to utilize the most economical available fuels. It permits the burning of a variety of coals without slagging, minimizes external corrosion of superheater tubes, and assures safe metal temperature, thus prolonging tube life, regardless of the fuel fired.

. . . It provides safe superheater tube temperature by positive gas temperature control; it protects superheater during startup and under all operating conditions.

. . . It makes it safer to design for economies offered by operation at steam temperatures of 1050 F and above.



THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-934

For more facts circle 205 on Reader Service card, p 121

AT ASHLAND, KY. WORKS OF ARMCO STEEL CORPORATION

"Increased boiler capacity can often be obtained by modernizing boiler cleaning equipment. Another benefit of such modernization is more efficient utilization of the fuel . . . getting more heat into the steam for useful work and wasting less heat up the stack.

For example, at the Ashland, Kentucky Works of the ARMCO Steel Corporation there are four boilers that were unable to supply the growing steam requirements of the plant. The high exit gas temperatures suggested that a study be made to determine whether the cleaning could be improved to provide additional capacity. This study indicated that more steam from the same fuel could be expected if high pressure long retractable blowers were used for cleaning instead of the rotary blowers with which the boilers were originally equipped.

The expected results seemed sufficiently promising and it was decided to modernize the cleaning equipment of one boiler. The seven rotary blowers were replaced with four Diamond Long Retracting Blowers, one of which is shown below. This modernization proved to be justified as the boiler's maximum steam output was increased 11% and the exit gas temperature was reduced approximately 100° F.

A "Boiler Cleaning Modernization Program" is well worth careful consideration because it can mean substantial savings in so many ways. In addition to increased capacity and more efficient fuel utilization, there is reduced maintenance . . . also reduced operating costs when motorized units and automatic operation are installed. Even though your boiler cleaning was the best at the time it was installed, improvements since then will probably pay off. For many years Diamond has been doing continuous research to improve boiler cleaning and boiler cleaning equipment.

Ask the nearest Diamond office (or write directly to Lancaster) to make a study of your boiler cleaning . . . the possible savings may surprise you."

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

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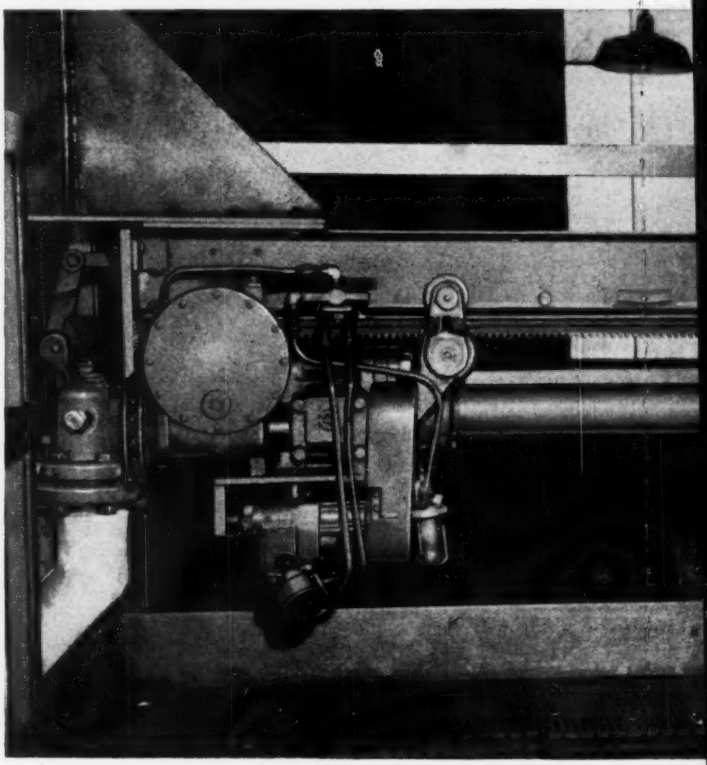


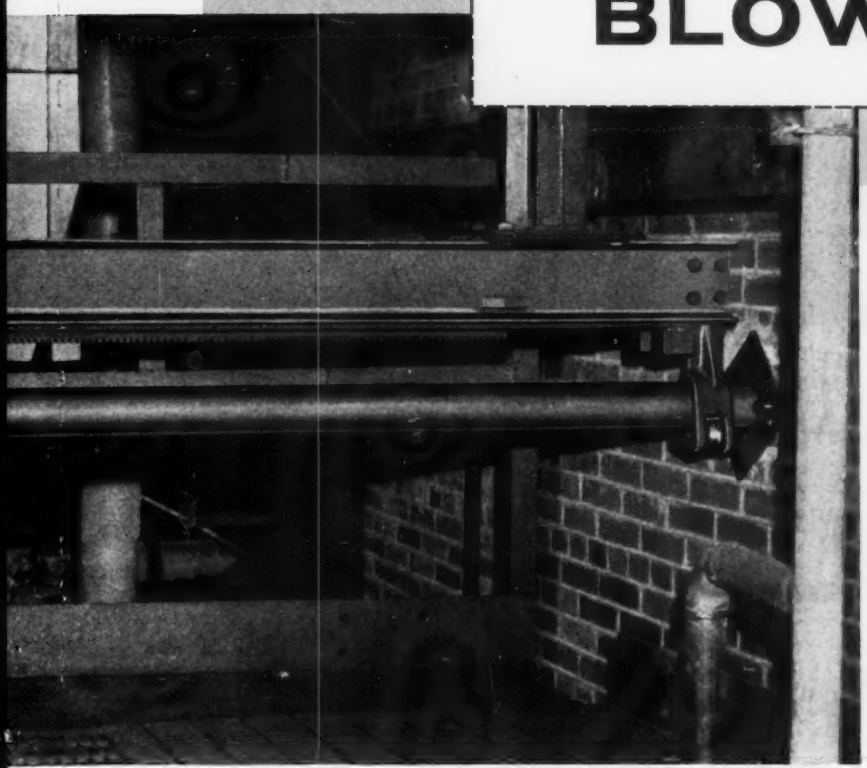
The Mark of

BETTER BOILER CLEANING AT LOWER COST

11% More Steam 100° F Lower Exit Gas Temperature

RESULT FROM BOILER CLEANING MODERNIZATION PROGRAM

Using DIAMOND LONG RETRACTING BLOWERS



One of the four Diamond Long Retracting Blowers used to modernize the cleaning of the first boiler at the Ashland Works of ARMCO Steel Corporation. The results were so satisfactory that the three other boilers in this plant are now also being modernized.

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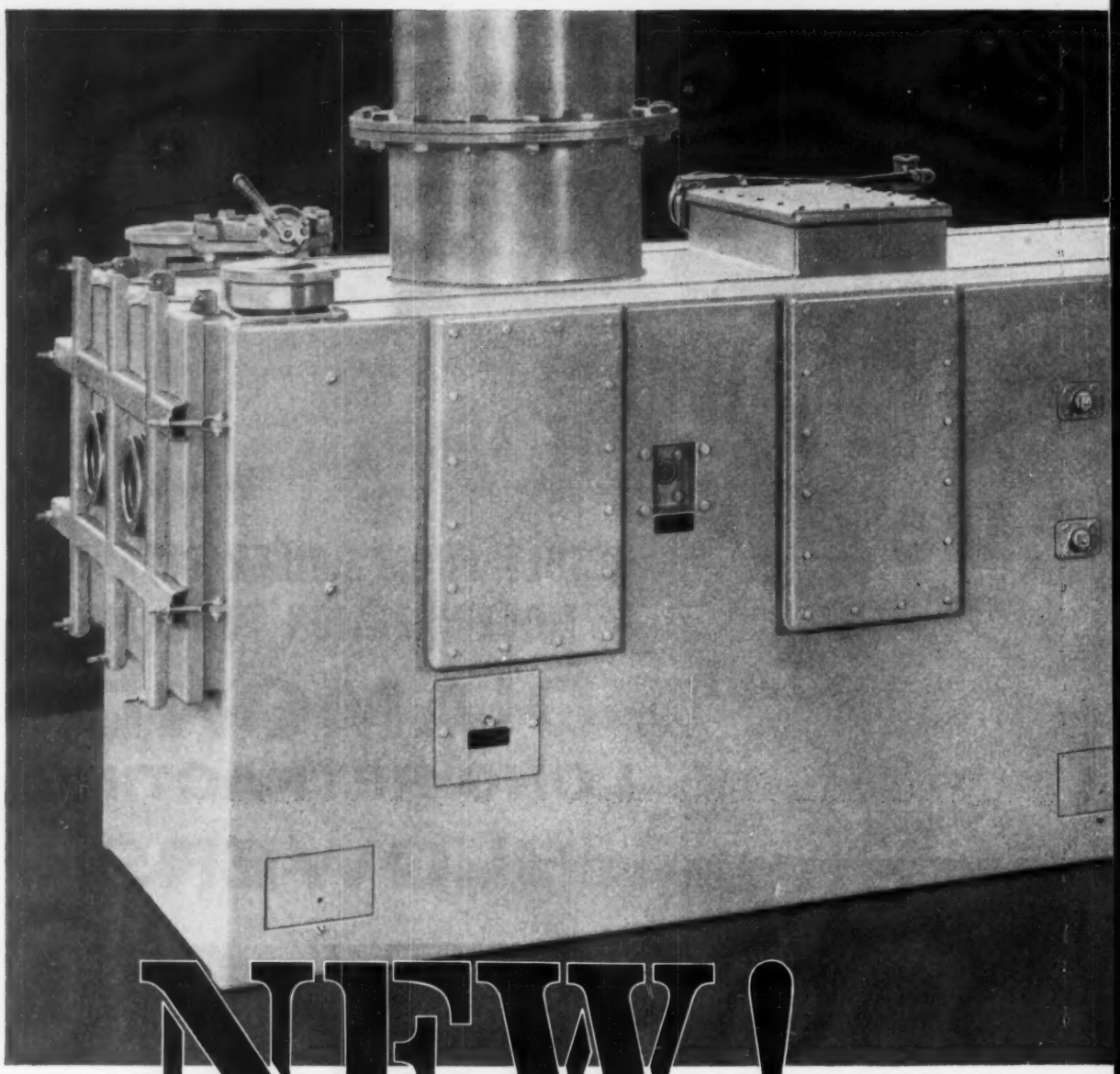
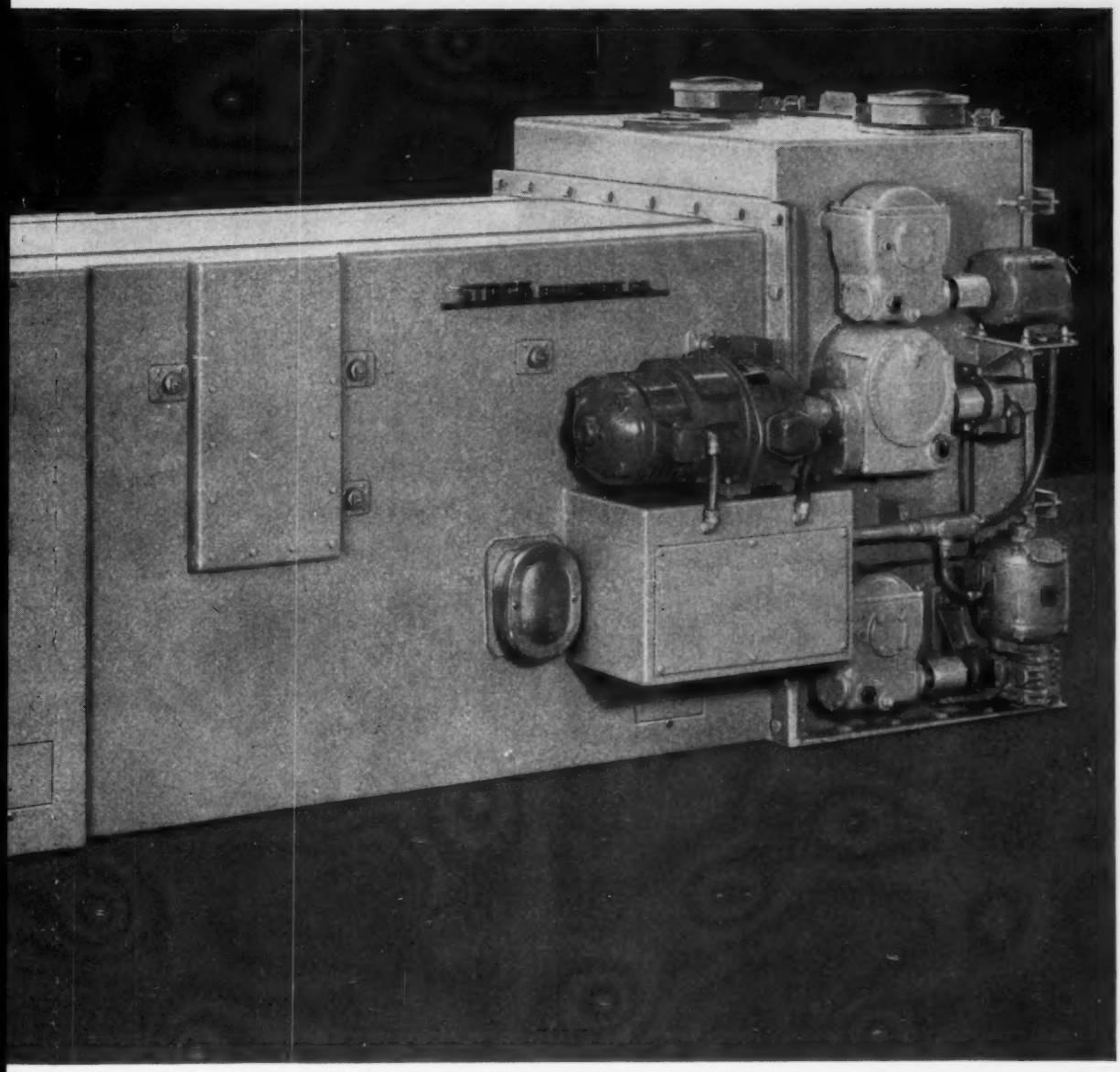


NEW!

A COMPLETE LINE OF

VOLUMETRIC BELT FEEDERS



To assure more reliable coal flow to pulverizers and cyclone burners, Stock Equipment Company has developed a complete line of Volumetric Feeders. The unrestricted 24″ width of coal stream is only one feature contributing to completely satisfactory operation even with fine, wet, sticky coal and with coal containing frozen or oversized pieces. The endless rubber belt used in the S-E-Co. Volumetric Feeder together with perfection in mechanical details provides long life with low maintenance.

Include S-E-Co. Volumetric Feeders in your next boiler specification.
Write for Bulletin!

by STOCK Equipment Company
725 HANNA BUILDING • CLEVELAND 15, OHIO

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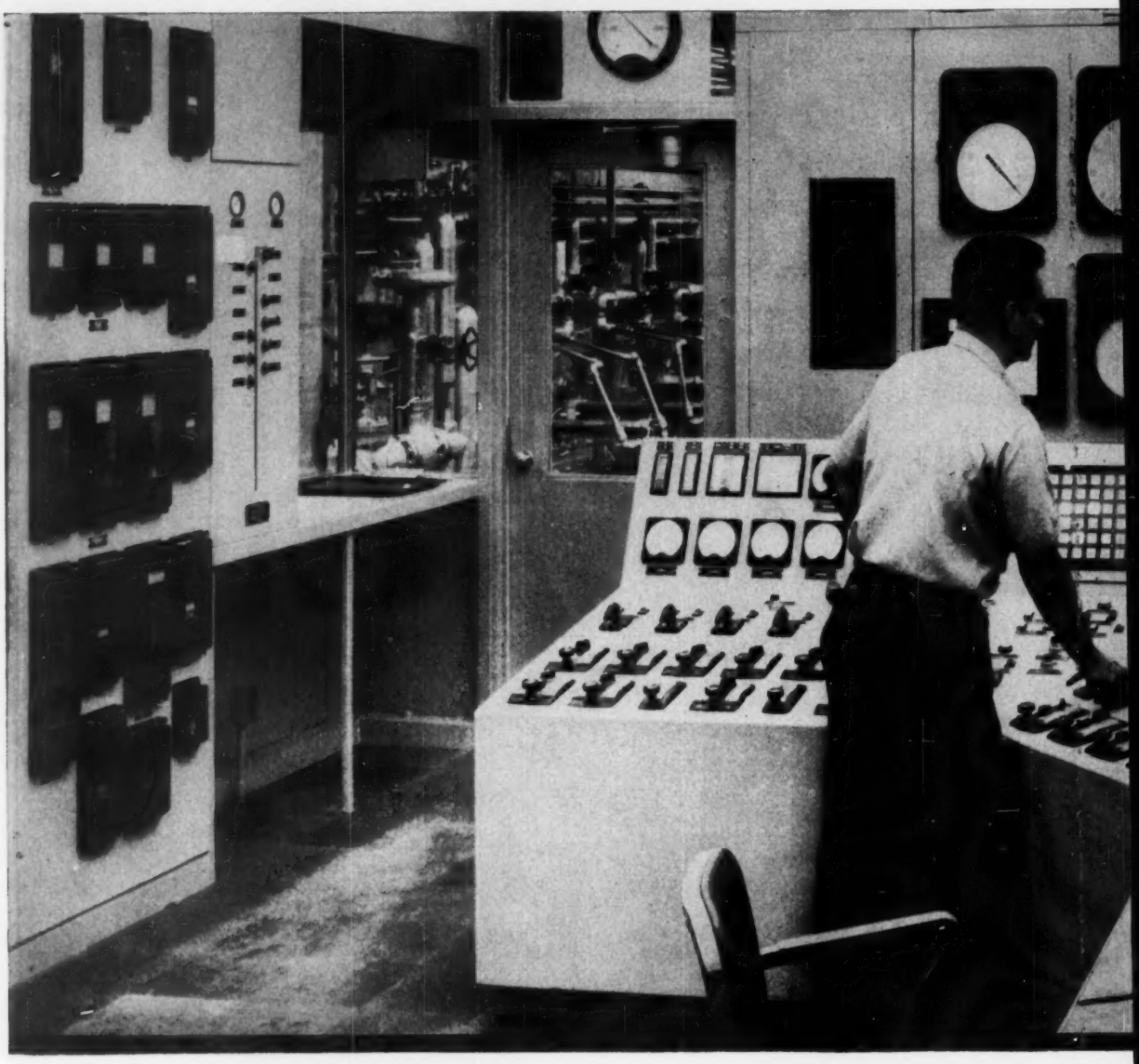


How Bailey stretches

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

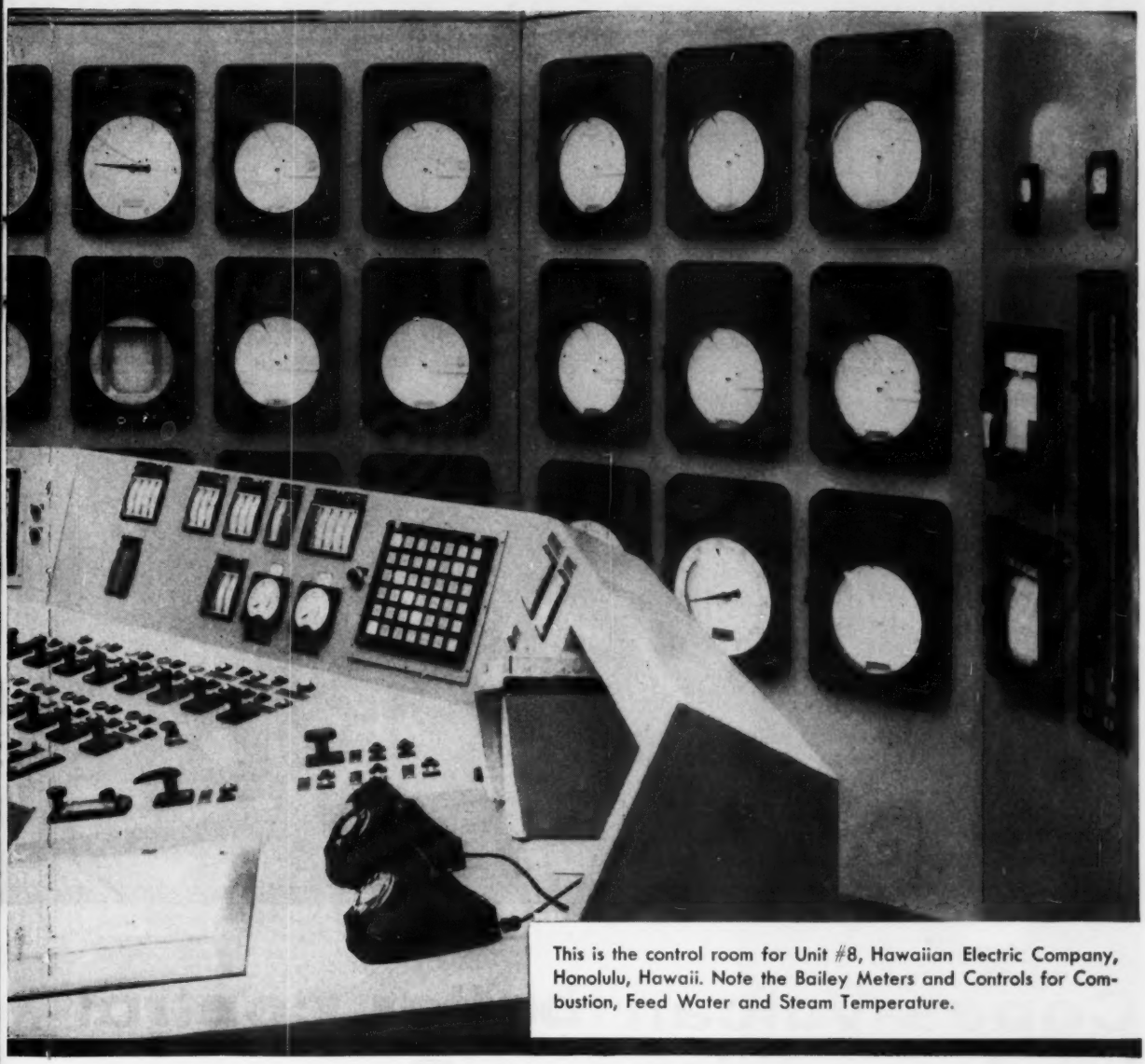
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



This is the control room for Unit #8, Hawaiian Electric Company, Honolulu, Hawaii. Note the Bailey Meters and Controls for Combustion, Feed Water and Steam Temperature.

your fuel dollar

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A132-2

BAILEY METERS

Instruments and controls for power and process

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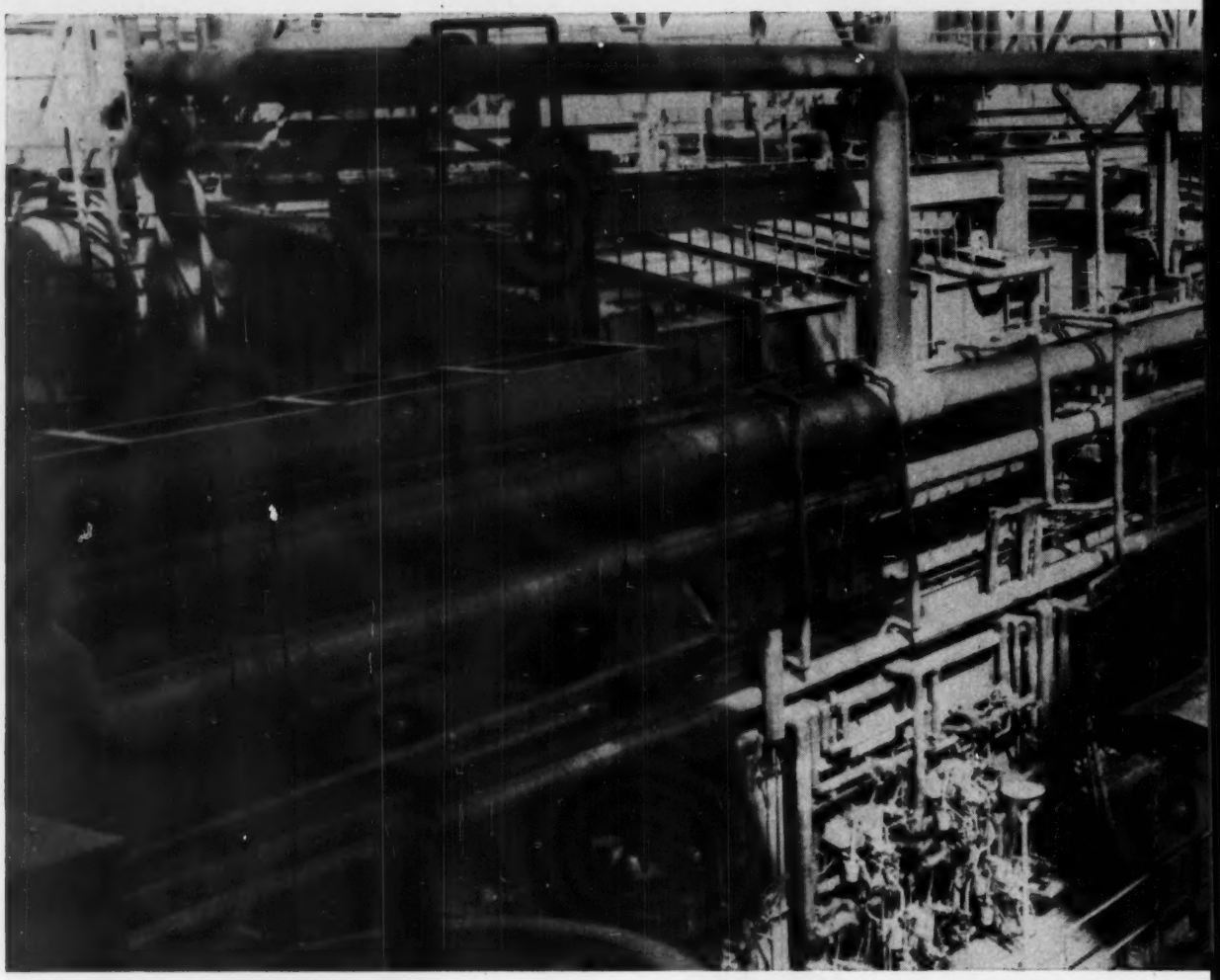


Copes-Vulcan boiler control load conditions at Deepwater

In addition to producing power for the Atlantic City Electric Company system, the Deepwater plant delivers steam to an adjacent chemical plant for process use.

To meet the widely fluctuating process demands, Copes-Vulcan controls the two low pressure boilers with precision responsiveness. Each boiler has a maximum continuous rating of 150,000 pounds per hour at 230 psig saturated. The system consists of:

Combustion Control maintaining a constant pressure in the main process steam header by holding steam output from the boiler equal to steam demand.

Copes-Type 3-L Feedwater Control modulated by three control influences—steam flow, feedwater flow and drum water level.

Boiler feed pump recirculation control protecting the boiler feed pumps against overheating on light loads.

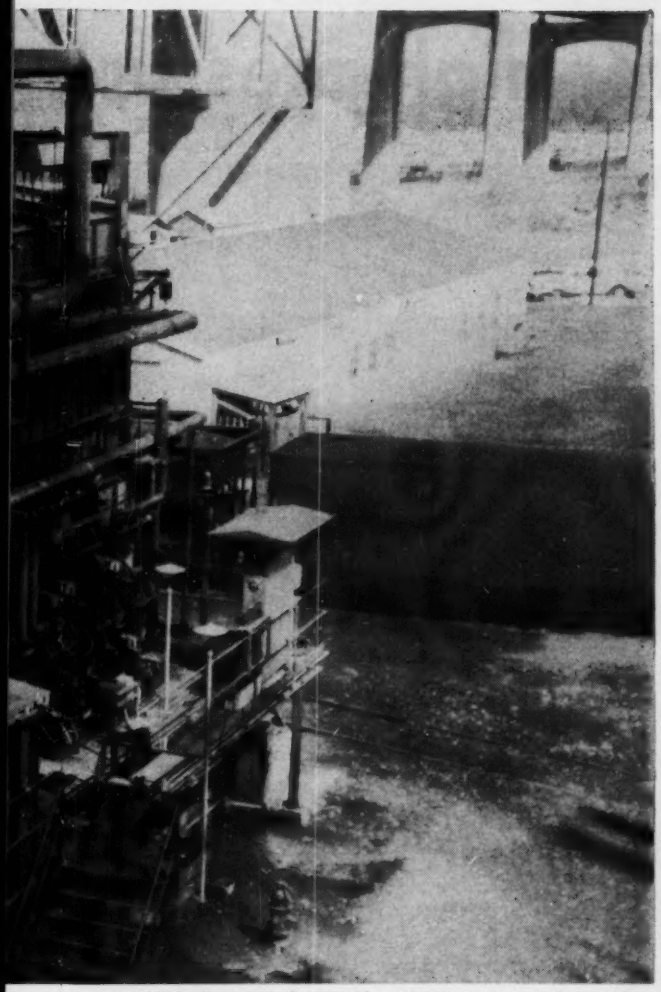
Vulcan Rotary Soot Blowers providing positive cleaning over the full blower arc, which may be as much as 360 degrees.

The system controls all equipment with either one or two boilers in service, permits each boiler to carry a different load. Control is automatic through a load range of 20,000 to 200,000 pounds per hour.

Whether your boiler is large or small, power or process, Copes-Vulcan can provide a unit or an integrated package, custom designed to your requirements. **For details on the Deepwater Station installation, write for Bulletin 1057.**

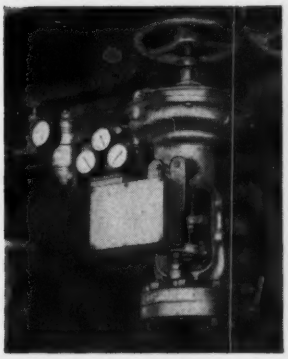
Copes-Vulcan Division
BLAW-KNOX COMPANY • Erie 4, Pennsylvania

BLAW-KNOX



Outside boilers and boiler controls subject to severe weather, with temperatures as low as 10° F. Except for the central control panel and relays and controllers mounted on it, the Copes-Vulcan control system is entirely outdoors.

meets unusual Station

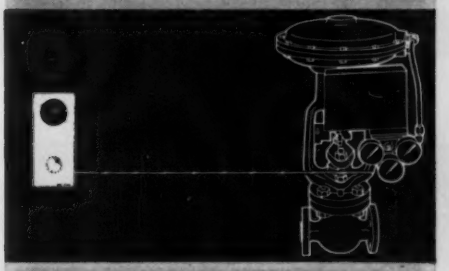


Diaphragm-operated CV-D valve controls the speed of the turbine driving the forced-draft fan. Copes-Vulcan also makes piston-actuated valves. Both types meet pressure standards of 125 to 2500 pounds.

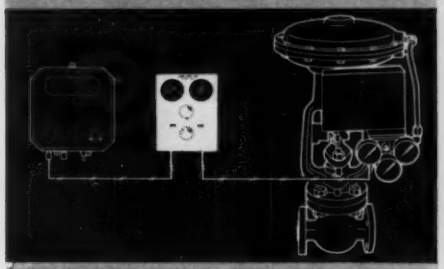
The drive unit with positioner, 4-way valve, power piston and feedback cam controls forced-draft damper. C-V drive units permit remote positioning by automatic or manual pneumatic signals.

C-V NEWS NOTES

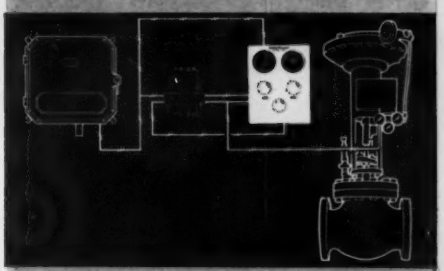
PNEUMATIC CONTROL STATIONS



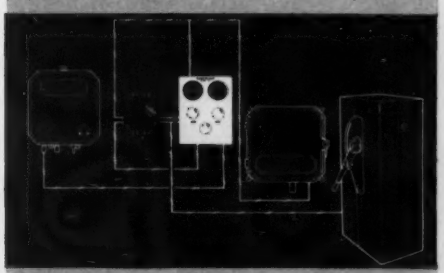
Copes-Vulcan stations offer automatic-to-manual selection without the complication of seal balance. They indicate process-variable, controller and manual loadings. Transfer is "bumpless" without process disturbance. Shown above: the ML-4 Manual Loading Station.



AM-4 Selector Station . . . indicates an automatic loading—or originates a manual loading—to the valve, power cylinder or other control element.



AMS-4 Remote Set Station permits manually adjustable set-point loading, or independent manual operation, of the control element.



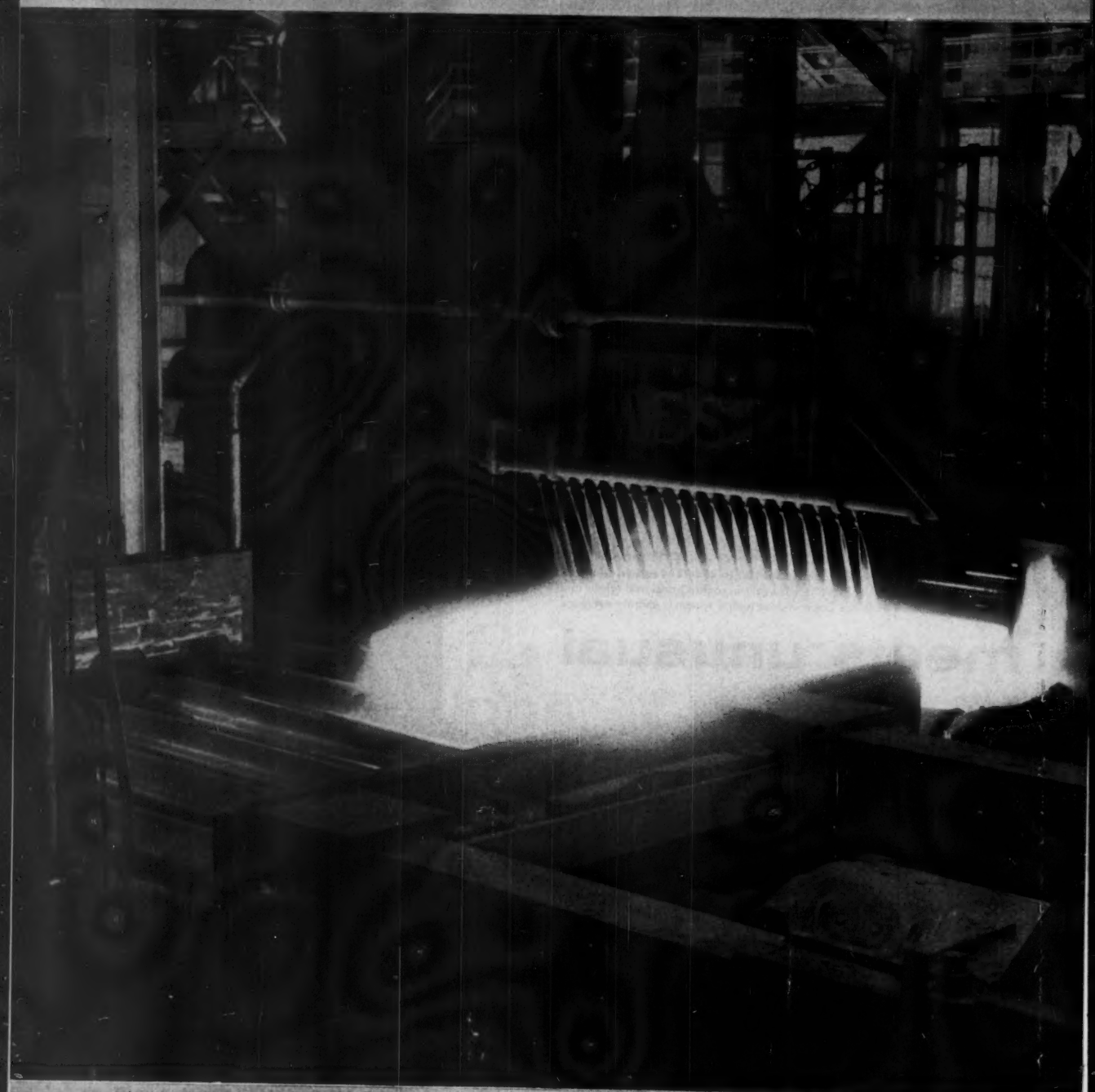
AMBC-4 Cascade Biasing Station, used with pneumatic stacked diaphragm controllers, permits plus-or-minus biasing of a cascaded set-point to the controller.

For details about Copes-Vulcan's complete line of pneumatic control stations, write for Bulletin 1081.

For more facts circle 209 on Reader Service card, p 121

DE LAVAL
CENTRIFUGAL PUMPS

for high-pressure

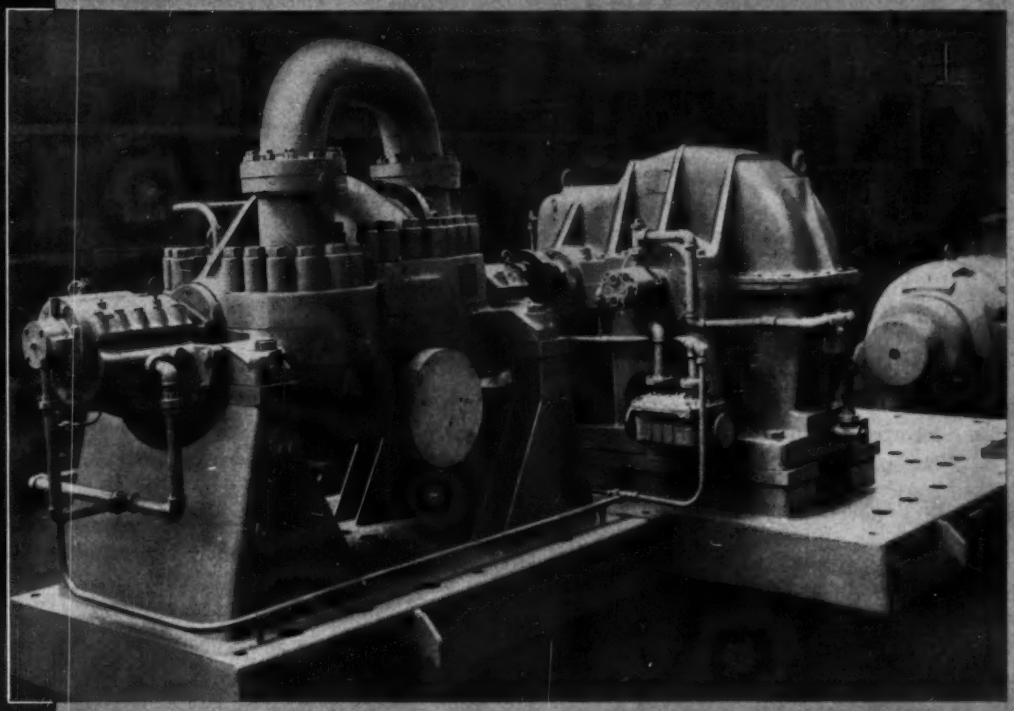


descaling at Lukens Steel

Latest successful technique of high-pressure descaling is now being performed in this modern steelmaking facility designed by Mesta Machine Co.

The initial high-pressure descaling operation uses De Laval split-case multi-stage pumps as shown in the photograph below. Each pump supplies cold water at 1000 gpm and 1600 psig. Electric motors rated at 1750 hp drive the pumps through speed increasers which raise the speed from 1200 rpm to 4250 rpm.

De Laval pumps also serve Lukens on a 1200 psig descaling system in another section of the Coatesville, Pa. mill.

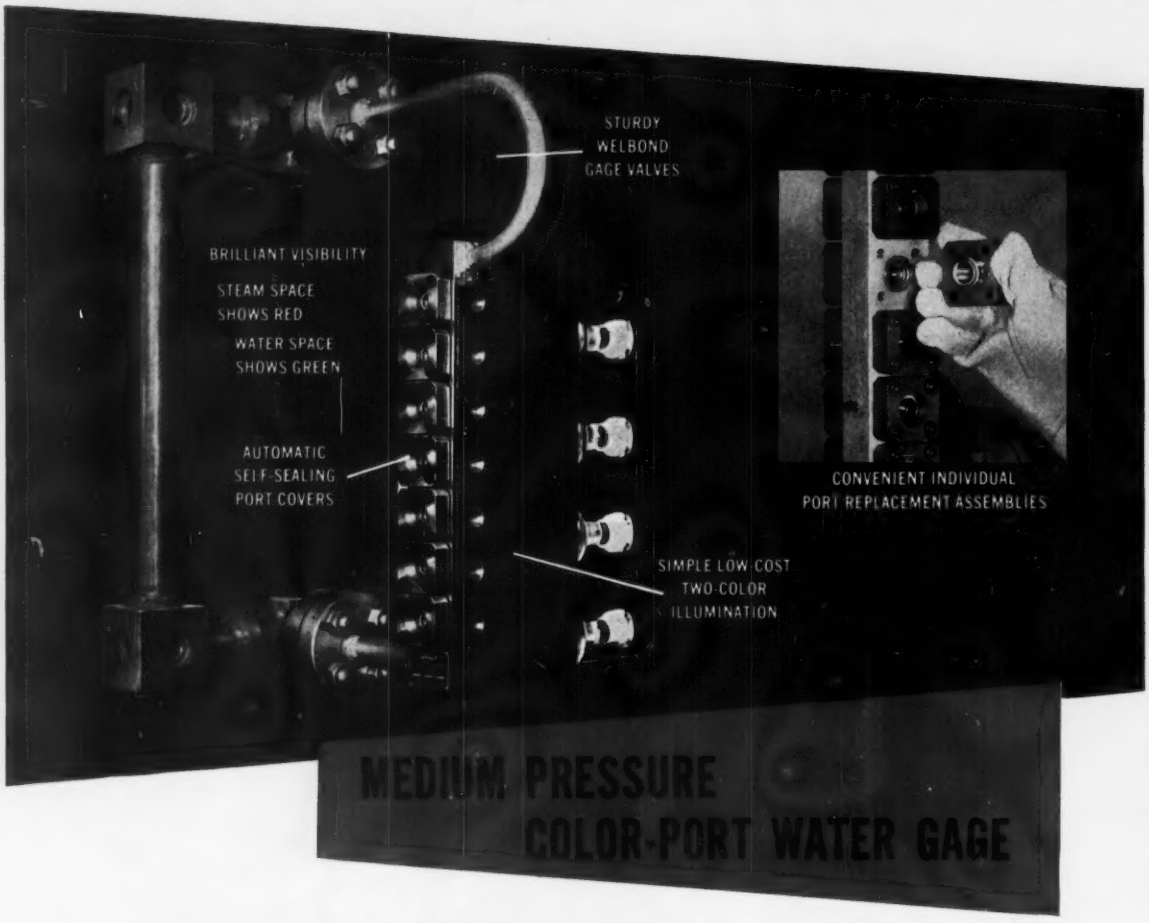


One of several arrangements available for descaling service at pressures of 1000-1200-1600 psig and capacities to 2200 gpm.

DE LAVAL *Steam Turbine Company*

815 NOTTINGHAM WAY, TRENTON 2, NEW JERSEY

NEW YARWAY TRIM FOR MEDIUM FEATURES AND DEPENDABILITY


STURDY WELBOND GAGE VALVES
BRILLIANT VISIBILITY
STEAM SPACE SHOWS RED
WATER SPACE SHOWS GREEN
AUTOMATIC SELF-SEALING PORT COVERS
SIMPLE LOW-COST TWO-COLOR ILLUMINATION
CONVENIENT INDIVIDUAL PORT REPLACEMENT ASSEMBLIES
MEDIUM PRESSURE COLOR-PORT WATER GAGE

These advantages, so successful in high pressure* Yarway Color-Port Water Level Gages, are now incorporated in the new Yarway Color-Port for boilers operating up to 1050 psi.

- Bright red and green readings. Full gage shows all green; empty gage, all red.
- Low maintenance. Individual port assemblies can be replaced in a matter of minutes—with the gage in place. Efficient illuminator spotlights reduce lighting costs.
- Automatic self-sealing ports. Exclusive spring loading of port covers maintains proper pressure on glasses and gaskets at all times.
- Sturdy Yarway Welbond Gage Valves for positive, dependable shut-off service.

For replacement on existing medium pressure boilers or specifying on new units, make sure your next gages are YARWAY COLOR-PORT. Visibility ranges of 13″, 15½″ and 18″ available.

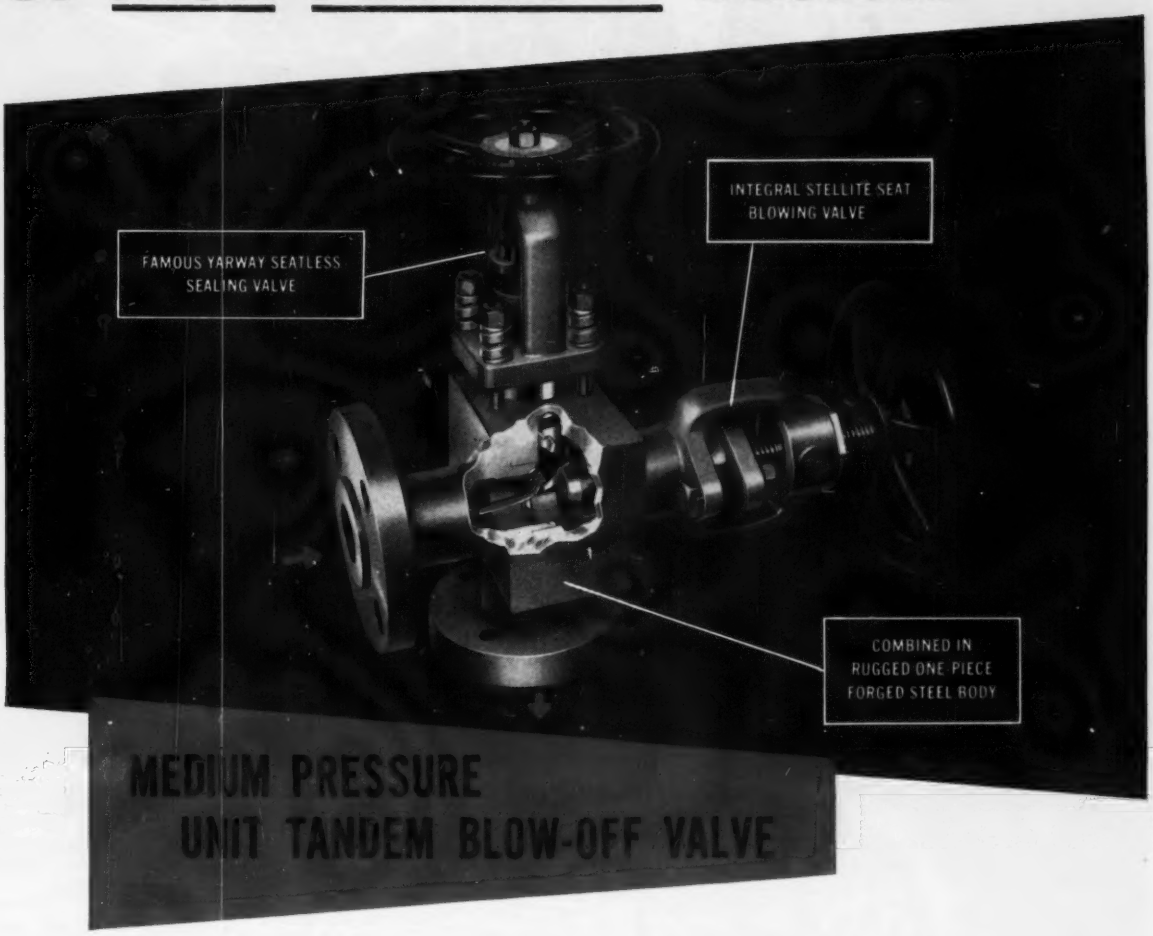
Write for new Bulletin WG-1815.

*up to 3000 psi

YARWAY

A MARK OF QUALITY

PRESSURE BOILERS HAS UNIQUE OF HIGH PRESSURE DESIGN


FAMOUS YARWAY SEATLESS SEALING VALVE
INTEGRAL STELLITE SEAT BLOWING VALVE
COMBINED IN RUGGED ONE-PIECE FORGED STEEL BODY
MEDIUM PRESSURE UNIT TANDEM BLOW-OFF VALVE

The established success of the high pressure Yarway Unit Tandem Valve is directly responsible for this new medium pressure Yarway Valve. It brings premium quality Yarway dependability to medium pressure boilers (up to 665 psi)—*at a competitive price.*

Important Yarway features like nitralloy plunger in the sealing valve, integral stellite seat and disc in the blowing valve, streamlined design, rugged forged steel body—make this your best blow-off valve buy.

Install this new Yarway Medium Pressure Unit Tandem and you'll know why *over 80% of all high pressure plants are Yarway Blow-off Valves.*

Write for Bulletin B-435, Supplement A.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

IN STEAM ENGINEERING

OIL'S FIRST CENTURY ~BORN IN FREEDOM WORKING FOR PROGRESS

IN the beginning there was a dreamer and a dream. The dreamer was Col. Edwin L. Drake - - - his dream was to drill the first oil well in the history of the world so the collection of oil could be simplified. To accomplish this end he needed a small boiler and a steam engine. These first pieces of steam power equipment were supplied to Col. Drake by a then relatively small progressive foundry and machine shop - - - Erie City Iron Works.

ERIE CITY Since 1840

★ OVER A CENTURY IN STEAM GENERATION WORKING FOR PETROLEUM

Now 100 years later the needs and the requirements of the giant oil industry are not quite so simple nor so easily solved. Numerous installations of large packaged and field assembled steam generators are required to produce the millions of pounds of steam used daily by the oil and petrochemical industries.

Erie City has kept constant pace with these industries. At first with small, low pressure boilers and presently with large capacity, high pressure, highly efficient, modern steam generators. Oil producing and processing plants all over are using Erie City boilers and allied steam generating equipment in their effort to satisfy our nation's basic needs.

A new general catalog describing all of Erie City's products is available. Write for Bulletin SB-6091-I.

You can depend on ERIE CITY for Sound Engineering

ERIE CITY IRON WORKS • Erie, Pa.

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
WASTE HEAT BOILERS • FIRE AND WATER TUBE PACKAGE BOILERS
OIL AND GAS BURNERS • STOKERS • PULVERIZERS

For more facts circle 212 on Reader Service card, p 121

The Right Refractory For Each Specific Need

IMPROVES BOILER

Harbison-Walker provides the most comprehensive line of Boiler Furnace Refractories

REFRACTORIES FOR MONOLITHIC CONSTRUCTIONS

Harbison-Walker Plastic Fire Brick, Castables and Ramming Mixes, comprise all the classes which are best adapted for the many different kinds of service and furnace design.

H-W Castable Refractories

These refractory concrete products all having a strong hydraulic set serve admirably for many boiler furnace and accessory uses as in pouring baffles, arches, walls, door linings, ash hoppers and sluicing troughs. Included in the eighteen different brands is H-W EXTRA STRENGTH CASTABLE which is exceedingly strong and wear resistant, yet has high spalling resistance and is suitable for use at temperatures up to 2400°F. H-W HIGH ALUMINA CASTABLE fulfills the requirements for highest operating temperatures. In the paper mill industry, H-W CHROME CASTABLE has become regarded as standard for linings of recovery boilers. The several H-W Lightweight Castables combine the desirable properties of light weight, heat insulation and adequate refractoriness for their applications.

H-W Plastic Fire Brick

Harbison-Walker Plastic Refractories comprise all brands best adapted for the many different operating conditions. They form solid, joint-free linings, and are used for the construction of arches, target, baffle and bridge walls, burner ports and irregular shapes. They have physical properties closely similar to corresponding classes of refractory brick.

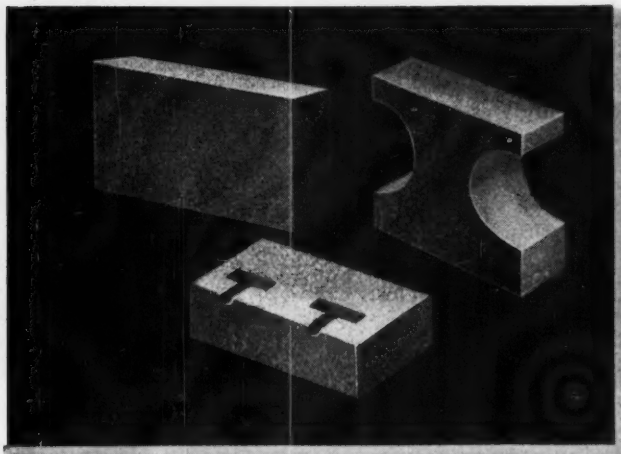
H-W STANDARD PLASTIC FIRE BRICK is a dense-burning, uniform refractory made of the same clean, high-purity flint clay of hard burn and plastic bond clay as are used in the best high duty fireclay brick.

H-W SUPER PLASTIC FIRE BRICK possesses the properties of super-duty fireclay refractories and is used economically in applications where temperatures exceed the limits for H-W STANDARD PLASTIC FIRE BRICK.

H-W SUPER PLASTIC-CS takes an air-set after drying in the low temperature range. This added strength prior to the development of the usual strong ceramic set is especially desirable for certain furnace installations.

To meet all the widely different conditions in the operation of steam power generating plants, Harbison-Walker produces the complete range of refractories from which can be selected the particular kinds for the best balance in service and economy. These refractories are manufactured in many states—and warehouse stocks are available in many cities and towns throughout North American and various other countries. Transportation time and cost benefits are obvious.

PERFORMANCE



APACHE Plastic Fire Brick is the high alumina plastic refractory which withstands the highest temperatures to best advantage and is most resistant to chemical attack by corrosive slags.

H-W Ramming Materials

THERMOLITH BATCH furnished both dry and ready mixed has a chrome ore base and because of the chemical composition and dense impervious texture developed when heated, it renders outstanding service in bottoms of slag tap boilers.

KORUNDAL RAMMING MIX (shipped dry) is a high alumina base material especially suited for use at extremely high temperatures.

HARBISON-WALKER REFRACTORY BRICK AND SHAPES WITH CORRESPONDING MORTARS

The many different brands of fireclay brick of all classes, high alumina brick ranging up to 99% alumina and H-W SILICON CARBIDE, along with corresponding mortars afford the best choice for substantially every combination of conditions. The H-W high alumina brands provide maximum resistance to exceedingly corrosive oil ash high in vanadium oxide and alkalies, ash of organic refuse including wood waste and sugar mill bagasse and certain coal clinker compositions. The H-W SILICON CARBIDE which is highly resistant to oxidation is best for withstanding the corrosive action of many fusible coal ash deposits.

H-W INSULATING REFRACTORIES

Harbison-Walker Insulating Fire Brick are made in eight different brands, each of which is suitable for use to best advantage for various sets of operating conditions. Other H-W insulating refractories are H-W BLOCK INSULATION and H-W MINERAL FIBER COATING. Included also are insulating castables ranging in weight from 30 to 85 pounds per cubic foot (weight of dense castables 115 to 180 p.c.f.) with service temperature limits from 1000°F. to 3000°F.

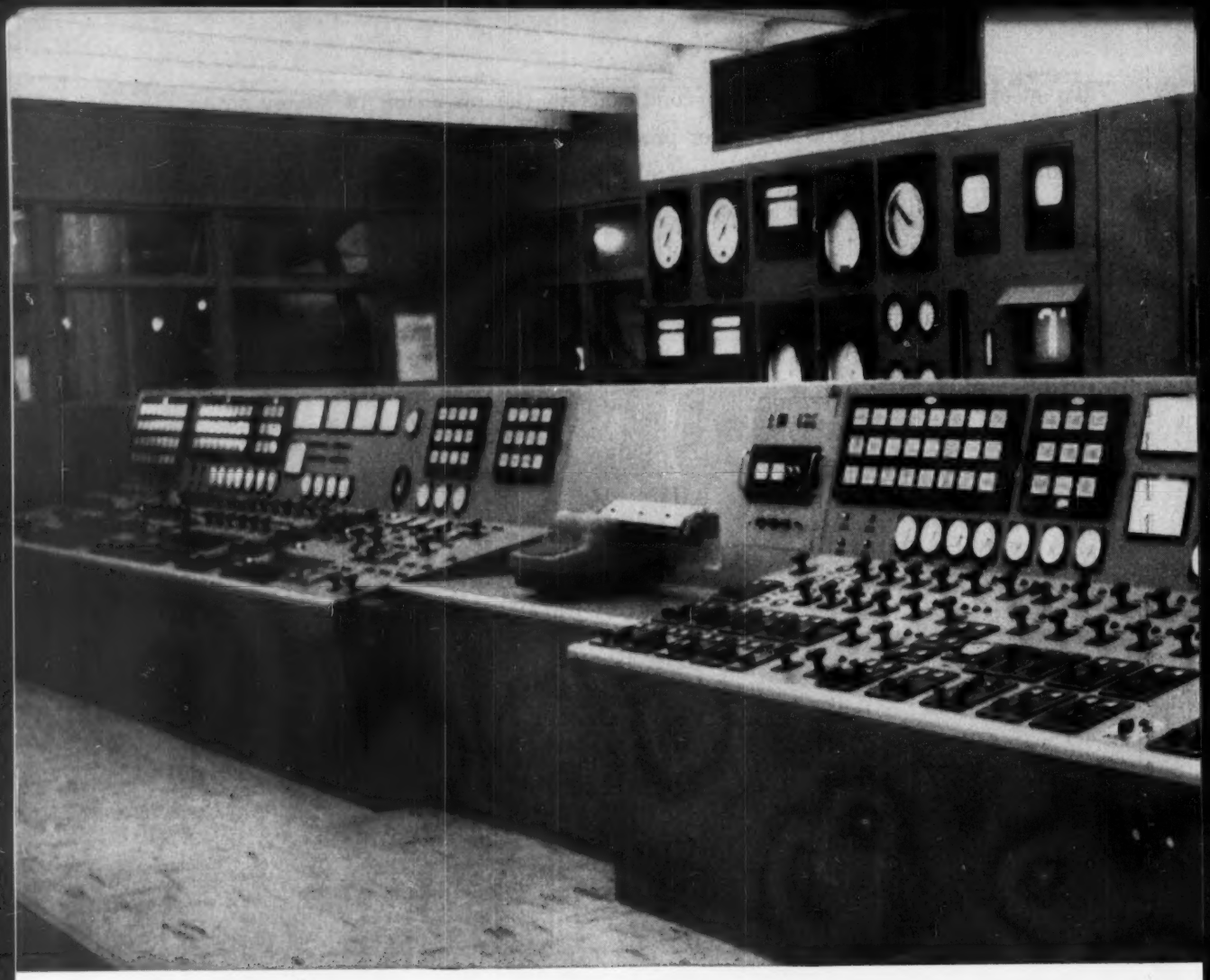
Technical Service based on the most extensive experience and research is freely offered to help you select the refractories best suited for your specific requirements.

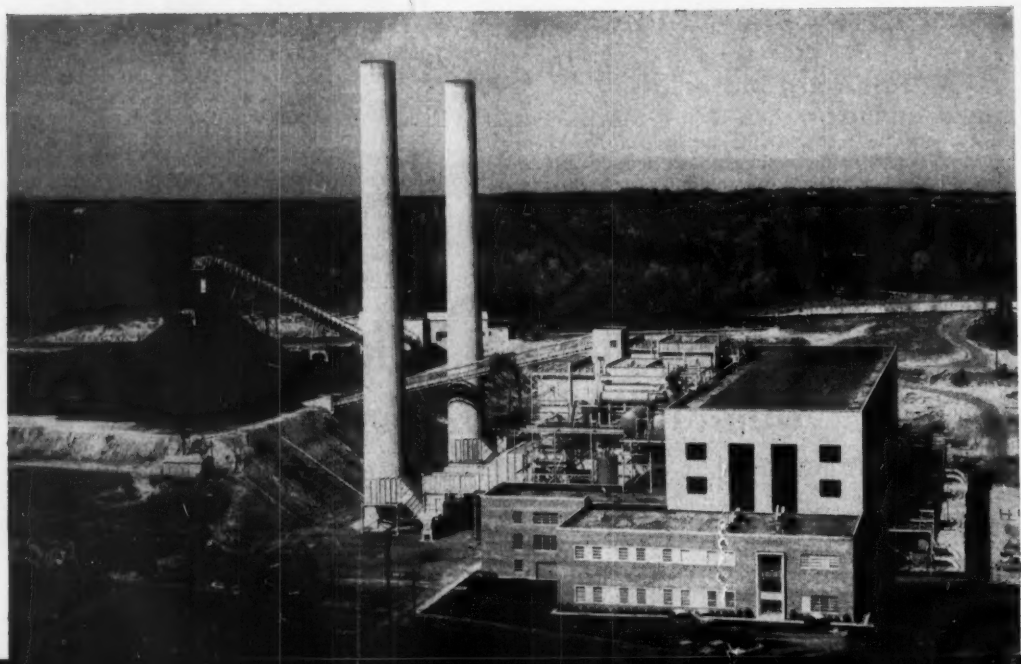
HARBISON-WALKER REFRACTORIES COMPANY AND SUBSIDIARIES

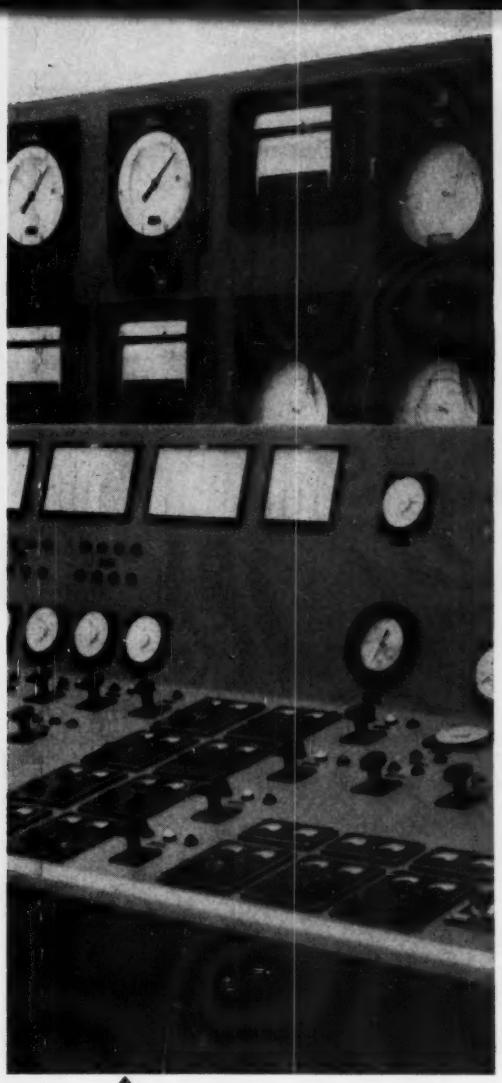
World's Most Complete Refractories Service

GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA

For more facts circle 213 on Reader Service card, p 121







Republic Electronic System Controls New McMeekin Station

At the new Silas C. McMeekin Station of South Carolina Electric and Gas Company two 910,000 lb/hr boiler systems are operating under all load conditions at maximum efficiency with the help of Republic Flow Meters Co. electronic combustion and feedwater control.

From the central control room—nerve center of the power plant—Republic electronic equipment in two master consoles provides continuous data and control for feed pump, feedwater, combustion, and superheat and reheat temperature. Important measurements of temperature, pressure, and flow are fed into an automatic data logging system and are recorded hourly. This complete control package was engineered by Republic working with Gilbert Associates, Consulting Engineers of Reading, Pa.

The Silas C. McMeekin Station is another example of Republic Flow Meters combustion control system engineering service at work. Republic's engineering experience in plants of all sizes, all pressure and temperature ratings and all load characteristics is your best guarantee of premium equipment performance. A technically-trained, thoroughly experienced Republic Sales Engineer is ready to discuss your instrument and control problems. Contact your nearest Republic representative, or write Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto. Subsidiary of Rockwell Manufacturing Company.

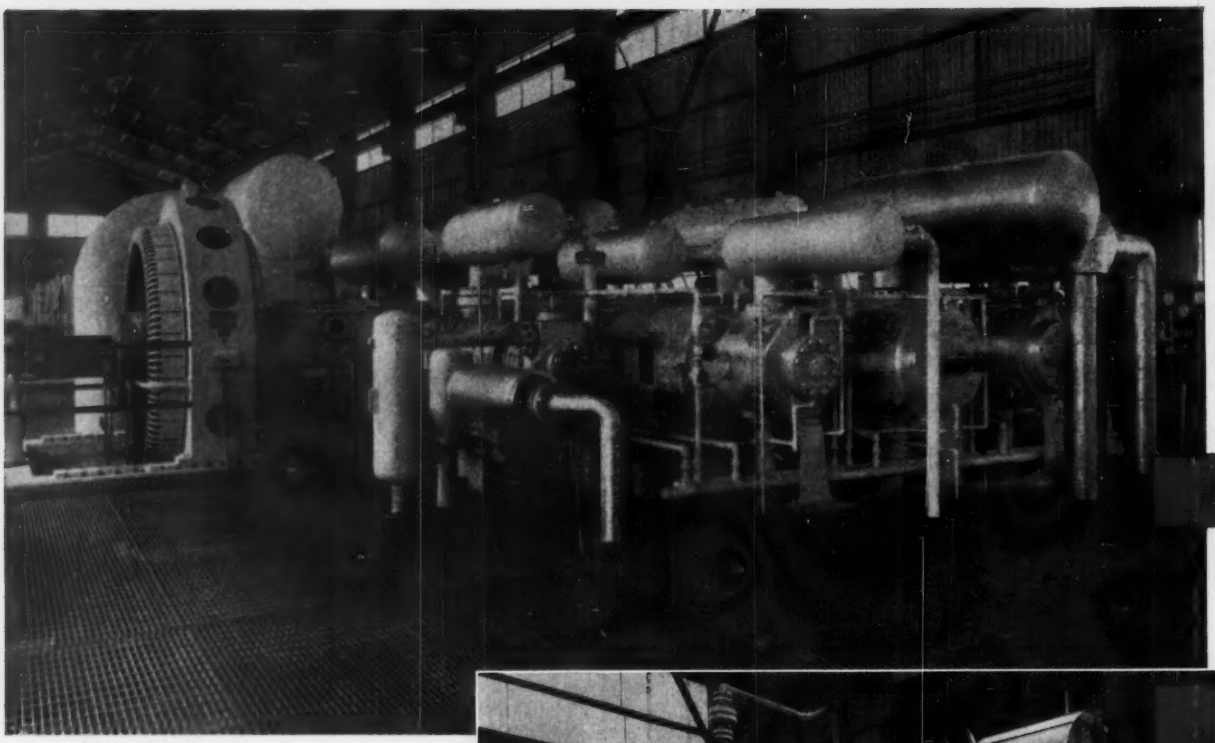
CENTRAL CONTROL ROOM

Located in control consoles are the vital Republic electronic combustion, feedwater, and temperature controls that monitor and regulate boiler system.

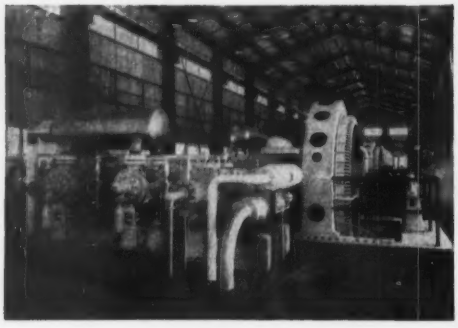
SILAS C. MCMEEKIN STATION

When operating at capacity, this new station can provide 2,409,000,000 kwh annually for the customers of South Carolina Electric and Gas Company.

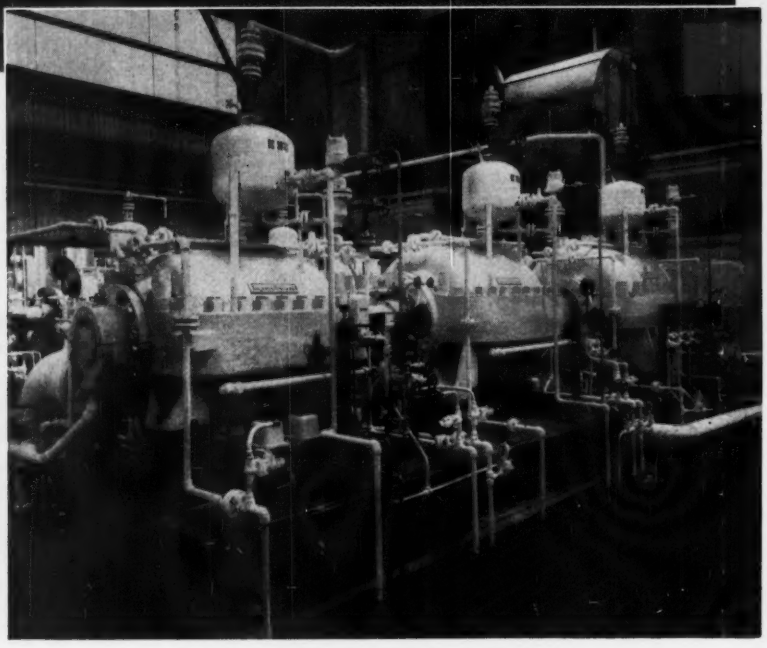
REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL



▲ Two 3500-hp HHE compressors in P.C.I. ammonia synthesis plant. Each 12-cylinder unit simultaneously compresses air and nitrogen, each in three stages; ethylene and high-pressure nitrogen, each in two stages; and low-pressure and high-pressure ammonia gas services, each single-stage.



▲ Two 3000-hp HHE hydrogen source gas compressors, each handling waste gases from Platformer, Hydroformer and butadiene plants, as well as ethane and methane residual gases, in eight separate compressor cylinders.



▲ Train of three multi-stage horizontally-split centrifugal units compressing ethylene gas to 396 psi.

▶ Train of four multi-stage horizontally-split centrifugals with gas-turbine drive, compressing 10,750 cfm of hydrocarbon feed gas to 525 psi at the P.C.I. ethylene plant.

◀ Two 4000-hp HHE's compressing ammonia synthesis gas in four stages to 9255 psi.

Ingersoll-Rand compressors and pumps serve all production processes for

PETROLEUM CHEMICALS, INC.

Among the world's most ultra-modern processing plants are the new ammonia synthesis and ethylene units of Petroleum Chemicals, Inc., at Lake Charles, La. The adjacent Calcasieu Chemical Corp. plant, newly-built and operated by P.C.I., is a major producer of ethylene glycol. In all three plants, Ingersoll-Rand equipment plays the lead role in pressurizing and moving the gases and liquids that keep these processes going 24 hours every day.

8 RECIPROCATING COMPRESSORS in Ammonia and Glycol Plants

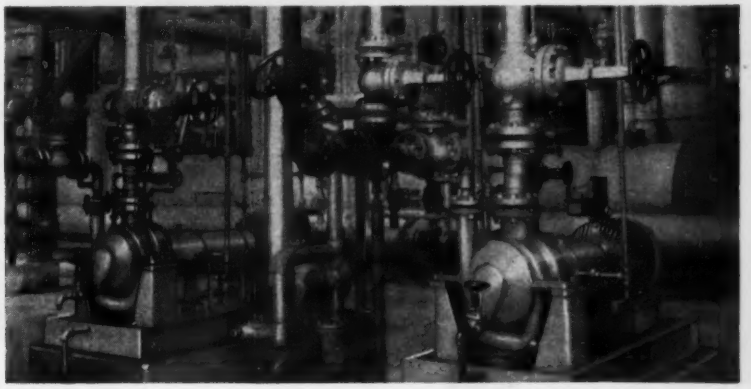
Six multi-stage Ingersoll-Rand electric-driven HHE compressors, totalling 21,000 hp, do all compression jobs in the P.C.I. synthetic ammonia plant. In the Calcasieu Chemical ethylene glycol plant, a four-stage HHE takes 80-psi air from an I-R centrifugal compressor and raises it to 2675 psi. A two-stage PHE compressor handles nitrogen.

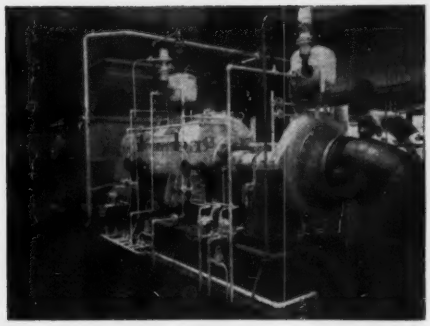
11 CENTRIFUGAL COMPRESSORS in Ethylene and Glycol Plants

Three trains of I-R centrifugal compressors (nine individual units) are at work in the P.C.I. ethylene plant. Each train is driven at approximately 7000 rpm by a 12,500-hp combustion gas turbine. In addition, there are two I-R centrifugals at the Calcasieu glycol plant: a multi-stage compressor discharging 80-psi air to the reciprocating unit mentioned above, and a single-stage blower boosting 8750 cfm of gas to 202 psig.

92 CENTRIFUGAL PUMPS in all three plants

The 92 Ingersoll-Rand pumps at Lake Charles include vertical and horizontal units in single- and multi-stage construction. They serve in all phases of production, handling cooling water, boiler feed water, light hydrocarbons and synthetic ammonia.





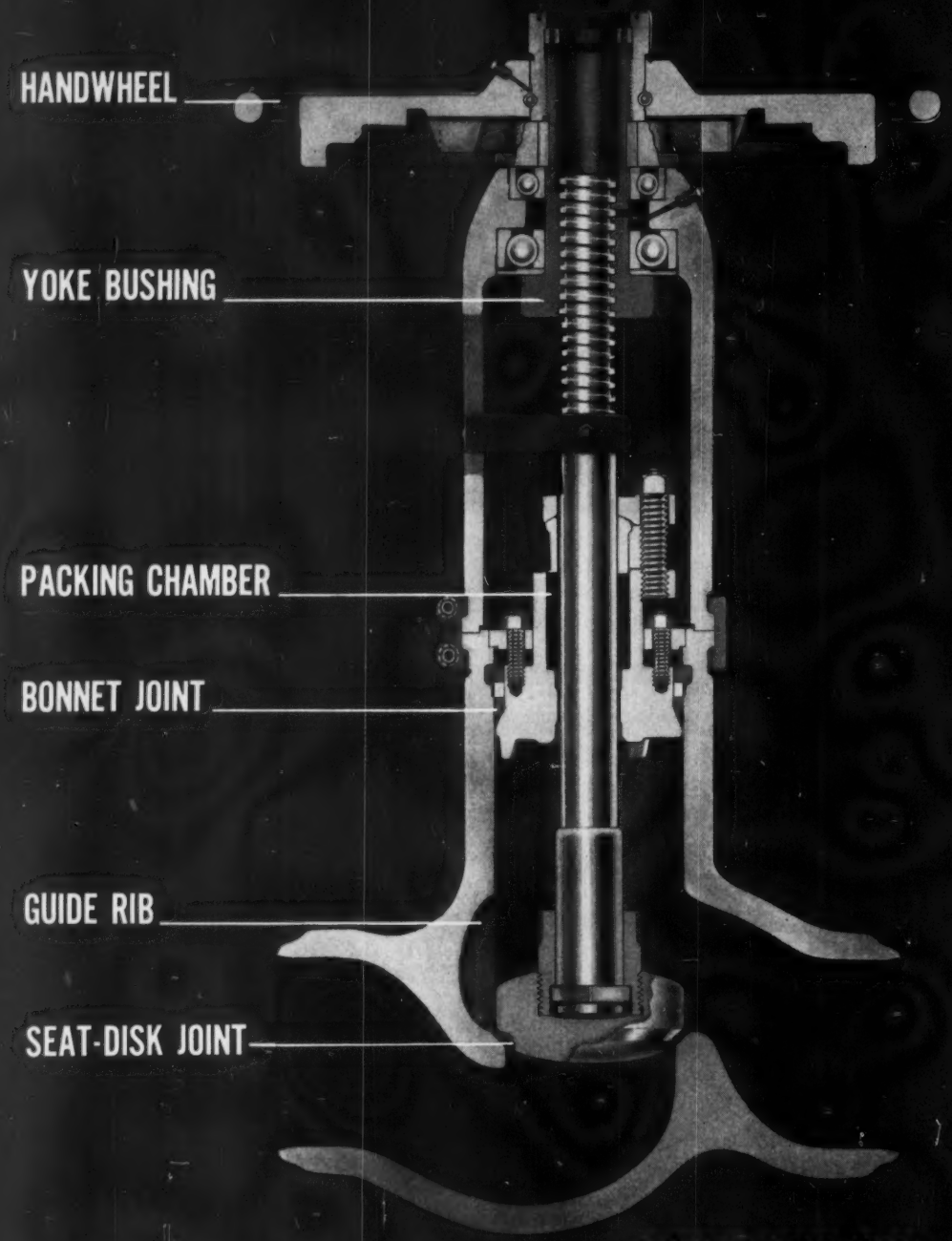
▲ Single-stage and multi-stage centrifugal compressors in tandem, handling propylene at 265 psi discharge.

Ingersoll-Rand

14-907 11 Broadway, New York 4, N.Y.

COMPRESSORS · ENGINES · PUMPS · AIR & ELECTRIC TOOLS
CONDENSERS · VACUUM EQUIPMENT · ROCK DRILLS

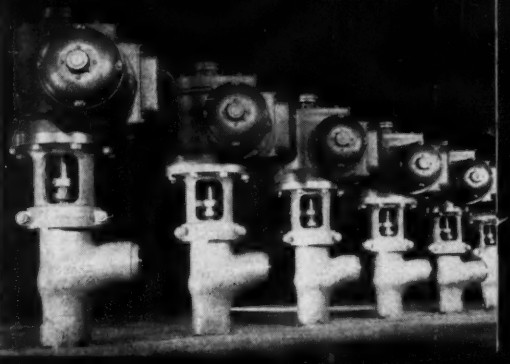
For more facts circle 215 on Reader Service card, p 121



EDWARD CAST STEEL
GLOBE VALVE FIG. 4016Y

IMPACTOGEAR® OPERATED VALVE

MOTOR OPERATED VALVES



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT CAST STEEL VALVES

Valves for today's high-pressure processes require economy, dependability and safety in operation. The material on these pages is designed to help acquaint you with a few basic principles and features you should consider when selecting cast steel valves 2½ inches and larger.

VALVE FEATURES FOR LONGER LIFE, EASIER OPERATION

Valve Handwheel should be large enough to operate valve easily. On smaller valve sizes, a knobbed handwheel design permits tighter grip. But for larger, high-pressure valves, impact-type handwheels will increase closing force, insure tighter closure (see large illustration opposite page). Quick closing can be obtained with impact-type handwheels geared for closing with the aid of portable air or electric wrenches (bottom-left, opposite page). Or, where central or automatic control is desired, consider fixed motor operation (bottom-right, opposite page).

Yoke Bushing on larger valves in higher pressure classes should be equipped with double ball-bearing construction for reduced operating torque and effective transmission of closing load (large illustration on opposite page shows this design). Material is important, too. On smaller valves, bushings of bronze will help prevent stem seizing or galling. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Packing Chamber should be large enough to insure long packing life. Valve packing must allow the stem to move within the bonnet but must not allow any fluid leaks between them. Well made packing, formed specifically for the packing chamber and correctly compounded for your pressure-temperature service conditions, has much to do with satisfactory valve performance. Valves with a positive backseat for re-packing while under pressure offer additional operating advantages.

Bonnet Joint of bolted construction (see Fig. 618 this page) is easiest to work with on medium or small size valves. But for lasting bonnet joint tightness, in high-temperature services (and for reduced size and weight), pressure-seal bonnet joint design is best—no flanges or bolting to periodically restress (see large illustration opposite page). Not all pressure-seal designs are alike, however. Avoid gaskets with small sealing surfaces and sharp edges that can be easily damaged and large threaded gasket loading mechanisms that are hard to disassemble and give unknown gasket compression.

Disk Guiding that properly centers the disk into the seat for positive shut-off regardless of position is important. Valve bodies with integrally cast guide ribs supporting disk throughout travel are best. Avoid designs which attempt to guide by installing spider in seat opening.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard-faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750° F.

Body Design with streamlined flow passage areas (opposite page) reduces wear-producing turbulence, decreases pressure drop and delivers maximum flow. Valves with streamlined body contours will often permit the use of smaller pipe and valve sizes. Angle valves (see Fig. 7517Y, upper right) have even less pressure drop.

For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame Street, W., Montreal 1, Quebec.

Edward Valves builds a complete line of cast steel stop, check, non-return, stop-check and gate valves for pressures to 10,000 lbs. available with flanged or welding ends. Below are illustrated a few of the major valve designs from this complete line.

Fig. 7517Y
Angle stop valve, 1500 lb at 850 F. (3600 lb WOG), with integral Stellite seat, Stellited disk, pressure-seal bonnet, welding ends. 2½" to 14".

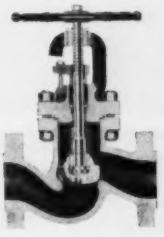


Fig. 618
Globe stop valve, 600 lb at 850 F. (1440 lb WOG), bolted bonnet, flanged ends, integral Stellite seat, Stellited disk. Sizes 2½" to 6".

Fig. 607Y
Angle non-return valve, 600 lb at 850 F. (1400 lb WOG), with pressure-seal bonnet, integral Stellite seat, Stellited disk-piston, welding ends, sizes 8" to 14".

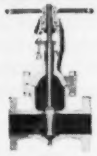


Fig. 611—Gate valve, 600 lb at 850 F. (1440 lb WOG), with hard-surfaced seats and wedge, ball bearing yoke, flanged ends. Sizes 2½" to 12".

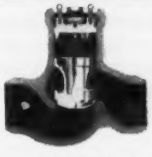


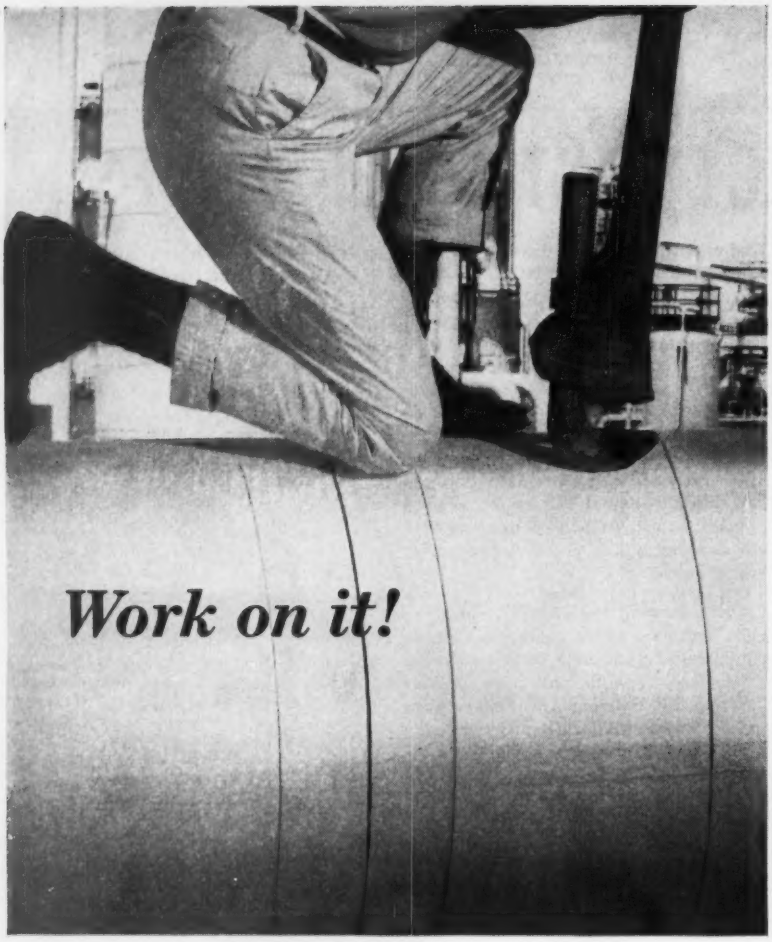
Fig. 4094Y—Horizontal check valve, 900 lb at 850 F. (2160 lb WOG), with integral Stellite seat, Stellited disk-piston, pressure-seal cover, welding ends. Sizes 2½" to 14".

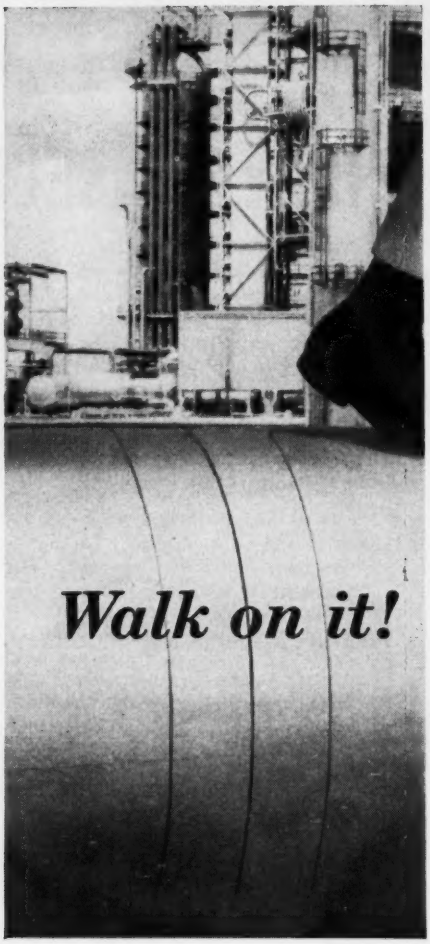
Fig. 7514—Flite-Flow globe stop valve, 1500 lb at 850 F. (3600 lb WOG) or 2500 lb at 850 F. (6000 lb WOG), with extremely low pressure drop and other premium features. Sizes 10" to 18".

EDWARD STEEL VALVES
another fine product by
ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs: with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

For more facts circle 216 on Reader Service card, p 121





J-M's new Metal-On® insulation is Thermobestos prejacketed in aluminum. Snaps on pipe quickly . . . surely. Saves the time and cost of separate on-the-job metal application.

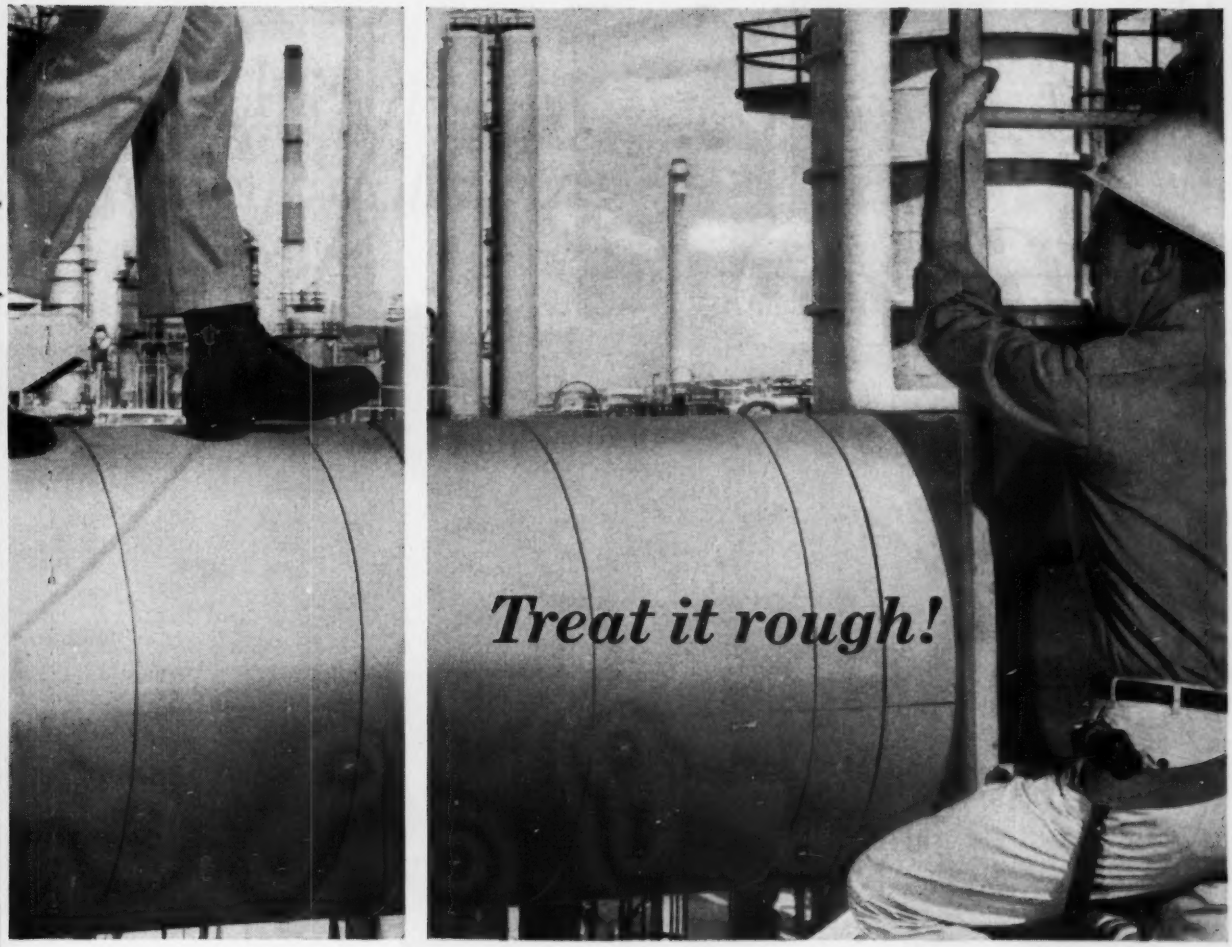
Seminars on best installation practices. For plant foremen who wish to keep up to date on new insulation methods and installation practices, J-M regional sales offices will gladly conduct insulation seminars. Contact nearest J-M office.

It's tough, durable Johns-Manville

Here's why Thermobestos is the preferred high-temperature calcium-silicate insulation . . . to 1200 F

You know the kind of treatment pipe insulation must take . . . day after day, year after year!

There's no better reason than this for the spiraling growth in Thermobestos® applications throughout the process and power generation industries —an insulation so strong and rigid, so resistant to crushing and compression it is almost structural.

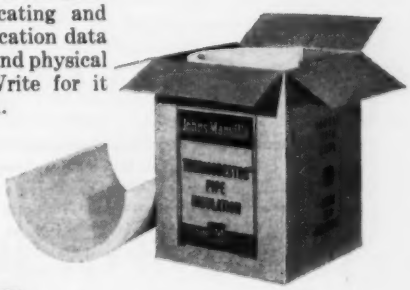


THERMOBESTOS insulation!

Equally important is the ability of Thermobestos to keep fuel costs low. Its *k* factor is the lowest of all insulations generally accepted for process applications. Its moisture resistance, unsurpassed.

Furnished in large, lightweight sections—precision-molded to unusually close tolerances—Thermobestos is easy to handle and install . . . readily adaptable to shop fabrication of fittings and bonds. Large selection of sizes, thicknesses (and quads up to 33″ pipe size) permit calcium-silicate installations that are entirely Thermobestos insulation.

You'll want the new Thermobestos booklet for your technical file. It contains complete information on prefabricating and installation practices . . . specification data . . . heat transmission tables . . . and physical and thermal characteristics. Write for it today. Ask for booklet IN-169A. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, 565 Lakeshore Rd. East, Port Credit, Ontario.



JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE

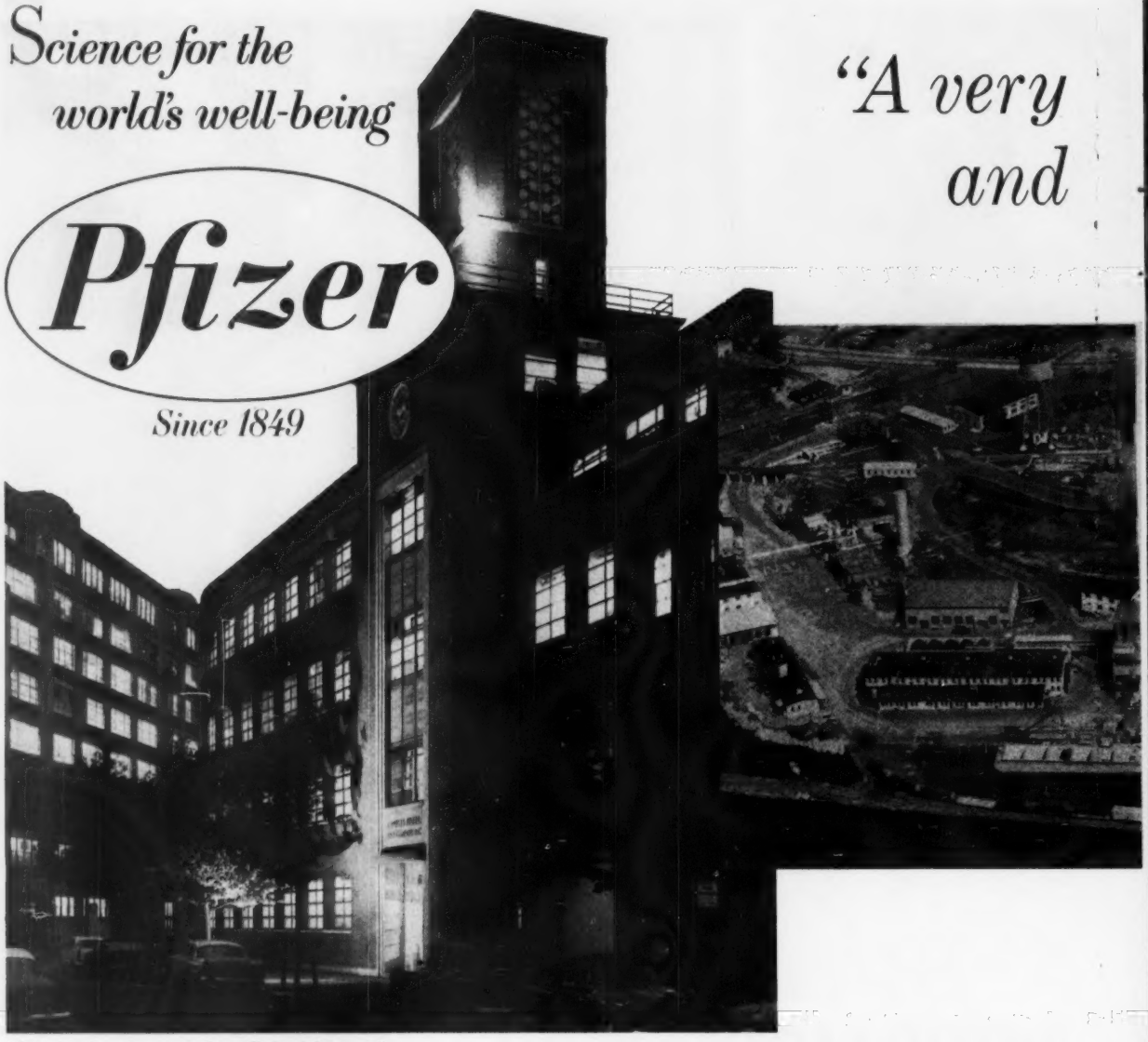
For more facts circle 217 on Reader Service card, p 121

Science for the world's well-being

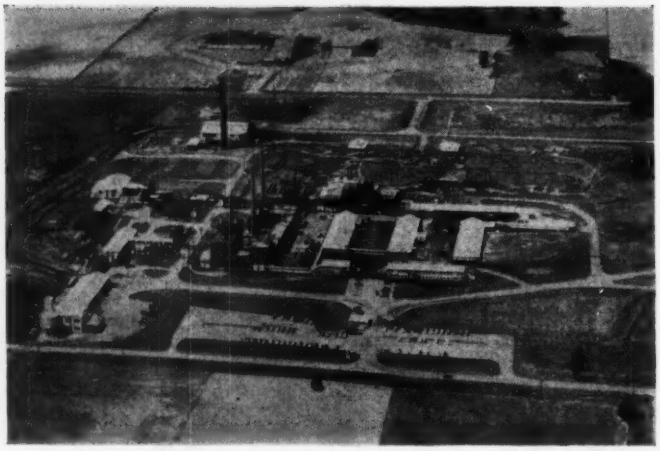
Pfizer

Since 1849

"A very and



Pfizer headquarters: executive offices and research laboratories in Brooklyn, New York. In the associated production plant, a modern Combustion VU-50 Boiler has been meeting essential heat and processing requirements during the past four years by producing 140,000 lbs of steam per hour.



Pfizer's Vigo Plant relies on four Combustion VM Boilers fired by C-E Spreader Stokers for economical heating and processing. Well suited to fill local needs, these units are each rated at 30,000 lbs of steam per hour at an operating pressure of 150 psi. In various Pfizer plants, nine C-E units have a total steam production capability of 740,000 lbs of steam per hour.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

satisfactory dependable Boiler"

says C. V. Reichelt, Director of Engineering, Chas. Pfizer & Co., Inc.

At this large Pfizer fermentation and organic synthesis plant in Groton, Conn., a new C-E Vertical-Unit Boiler, Type VU-50X, has just been placed on the line. Rated at 165,000 lbs of steam per hour — a new high for Pfizer — it joins three other oil fired C-E boilers, two VU-40 units and one VU-50 unit, already in service at the plant. Each is rated at 115,000 lbs/hr.

When Chas. Pfizer & Co., Inc., recently put into service a new C-E Vertical-Unit Boiler in their Groton, Conn., fermentation and organic synthesis plant, they were capitalizing on long experience. Eight previous C-E units, three of them at Groton, had been producing steam efficiently in Pfizer plants since 1948.

Mr. C. V. Reichelt, Director of Engineering, describes Pfizer's experience with its latest C-E unit as follows: *"The new 165,000 lb/hr boiler . . . is proving to be a very satisfactory and dependable unit. Particular commendation is made of the refinements with regard to air pre-heater and fly ash arrestors which Combustion Engineering included in their design. Special mention is also made of the fine job that was done in getting the boiler on the line on time in spite of a tight schedule for fabrication and erection. This boiler is the fourth and largest C-E boiler installed at our Groton facilities."*

With three other C-E Boilers at Groton, this unit is now producing steam for power and process in the production of the well-known Pfizer antibiotics such as Terramycin as well as for a wide range of pharmaceuticals and chemical and agricultural products.

Pfizer's experience with C-E boilers extends beyond Groton, too. At Terre Haute, Indiana, the company's Vigo Plant uses four Combustion boilers fired by C-E Spreader Stokers; and at the Brooklyn Plant, the company's original "shop", dating back to 1849, another C-E Boiler is entering its fourth year of service.

Today, in more than 100 countries around the world, Pfizer "Science for the world's well-being" contributes to the advance of medicine, agriculture and industry. Combustion Engineering is proud to have a share in this march of scientific progress.

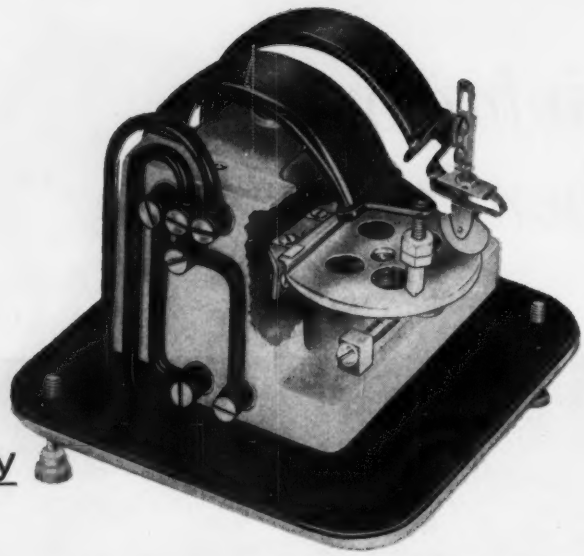
COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

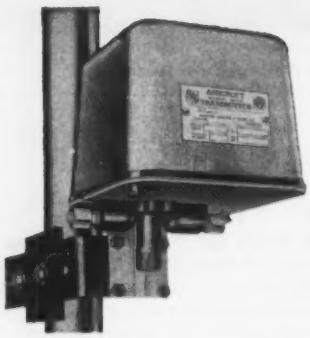
C-231

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 218 on Reader Service card, p 121



NEW
high sensitivity
ASHCROFT
PNEUMATIC TRANSMITTERS
lower costs...reduce maintenance ...provide tighter control



Ashcroft Non-Indicating Pneumatic Transmitters are made in pressure and temperature types, each in regular and short span. Operation is on low-pressure air: output range, 3-15 psi or 3-27 psi.

These new transmitters are designed around (1) a powerful, efficient relay with sensitivity high enough to operate controllers, and (2) a simple, dual Bourdon tube motion-balance system. High sensitivity permits the use of narrowest proportional band settings on controllers and allows instant controller response to deviations from set point. With a shorter transmission lag, automatic corrective action starts before the deviation becomes critical.

In manual control systems, these new Ashcroft Transmitters (teamed with suitable receivers) make it practical to operate boilers at the most efficient level. In wet processing operations, fractionating columns yield a purer product. Highly suppressed Ashcroft Short Span Transmitters are so sensitive they can "judge" entire control loops and detect any errors in the system.

Basically a 6″ cube, lighter than most 8½″ pressure gauges, these climate-proof Ashcroft Transmitters are simple to install in cramped locations, are most readily accessible for adjusting or service. Calibration is extremely easy, with linearity checking entirely eliminated. Most parts in all types in the line are interchangeable. Ask your nearby Ashcroft Gauge Distributor about the lower initial costs and other savings that follow when you install Ashcroft Non-Indicating Pneumatic Transmitters. Send for Bulletin 361.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

ASHCROFT PNEUMATIC TRANSMITTERS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 219 on Reader Service card, p 121

circle 220 on Reader Service card, p 121 ➤

COMPRESSOR QUIZ

Take this 5 minute quiz and check your knowledge of balanced opposed compressors.... ANSWERS ON NEXT PAGE. NO PEEKING!

1. What is the reason for an outboard bearing supported motor?

- ☐ Accessibility
- ☐ Shaft alignment
- ☐ Weight saving

2. Which design provides the smallest force couples?

- ☐ Bearing between the crank throws
- ☐ No bearing between the crank throws
- ☐ Both are equal

3. Structurally, what's the critical point in the multi-crank horizontal compressor from a design viewpoint?

- ☐ Lateral forces in the frame
- ☐ Vertical forces in the frame
- ☐ Cylinders

4. What type of motor is usually used on a balanced opposed compressor?

- ☐ Induction
- ☐ Engine-type synchronous
- ☐ Wound rotor

5. Can machine-mounted coolers and interstage piping be factory pre-fitted?

- ☐ Yes
- ☐ No
- ☐ Only on simple arrangements

6. Why is the balanced opposed compressor easier to install than other types of equivalent size?

- ☐ Lighter weight
- ☐ Less parts
- ☐ Semi-packaged design

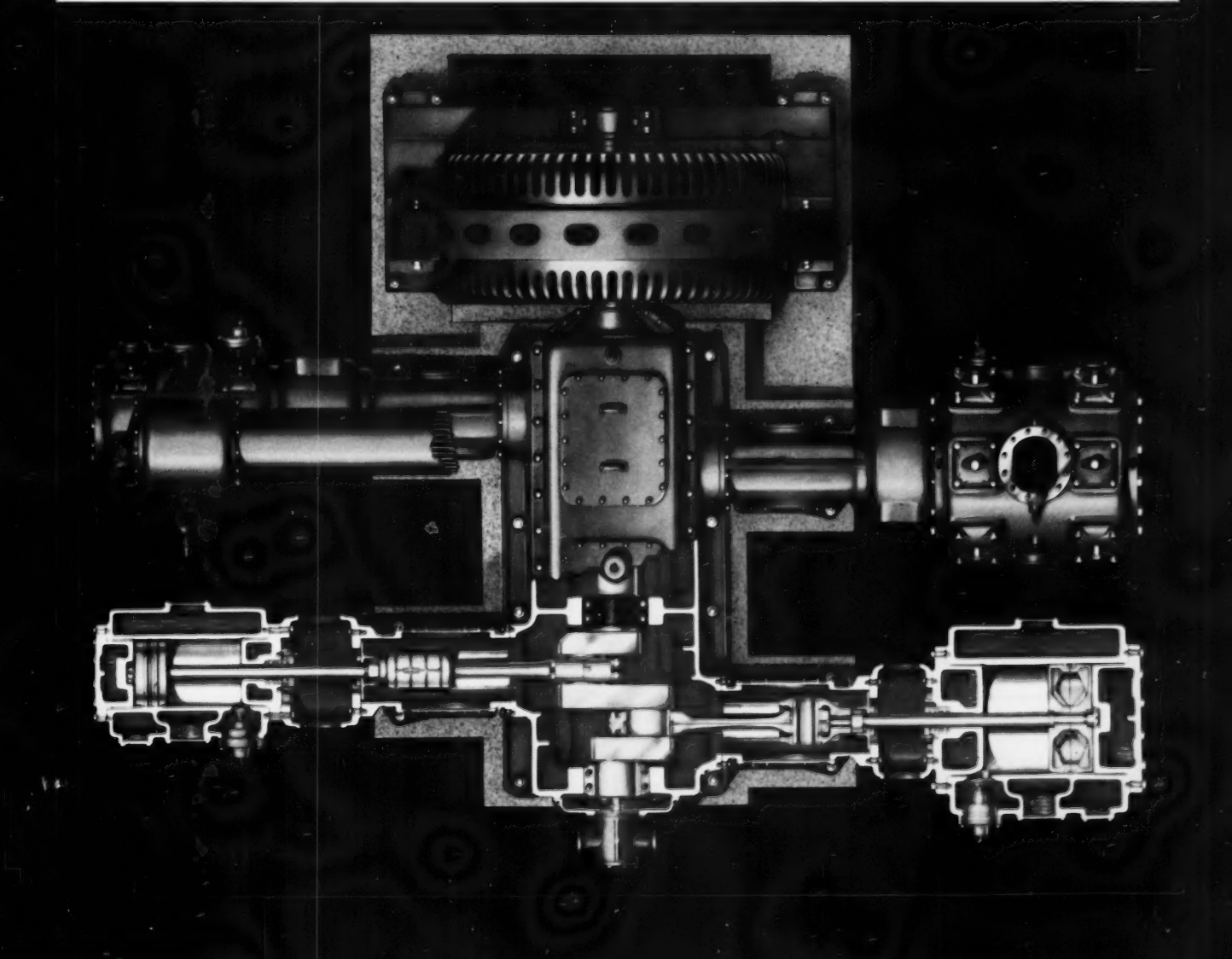
7. Is it common practice to install more than one compressor service on a single multi-cylinder frame?

- ☐ Yes
- ☐ No

8. Industry's most preferred compressor valve is standard with Worthington. It is:

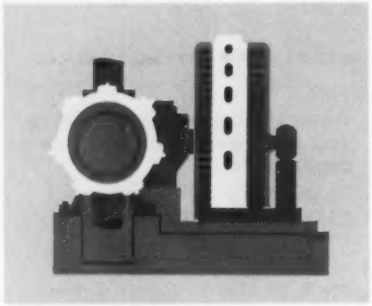
- ☐ A plate valve
- ☐ A spring activated valve
- ☐ A Feather Valve

WORTHINGTON



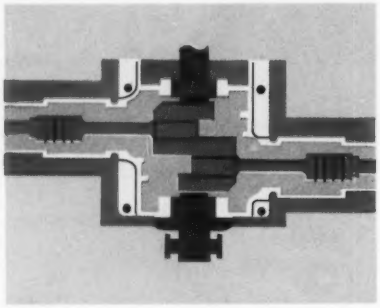
ANSWERS

to key compressor questions on previous page



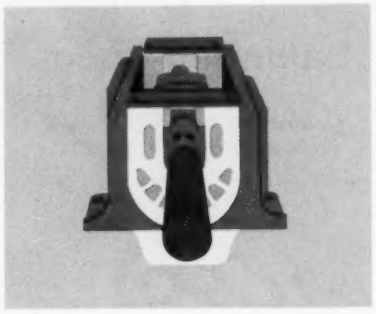
1. What is the reason for an outboard bearing supported motor?

Ans: Shaft alignment. Secure and permanent support of the large synchronous motor rotor is best obtained by placing a bearing on each side of the rotor.



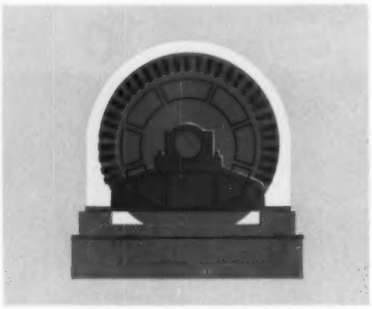
2. Which design provides the smallest force couples?

Ans: No bearing between the throws. Worthington's adjacent crank design reduces couple arm to a minimum.



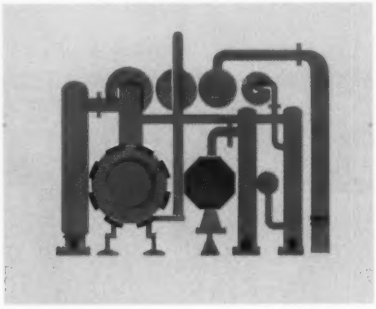
3. Structurally, what's the critical point in the multi-crank horizontal compressor from a design viewpoint?

Ans: Lateral forces in the frame which tend to distort the frame. Worthington's precision machined and fitted tie bars give solid support to the frame, preventing misalignment due to distortion.



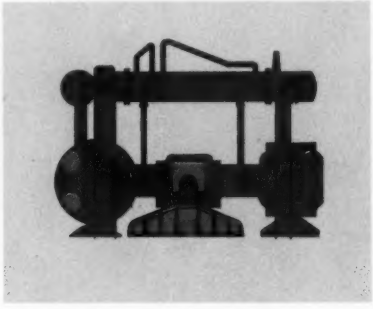
4. What type of motor is usually used on a balanced opposed compressor?

Ans: Engine-type synchronous is the major application; but complete flexibility of Worthington design permits use of any type driver, including turbine and gear or power engine.



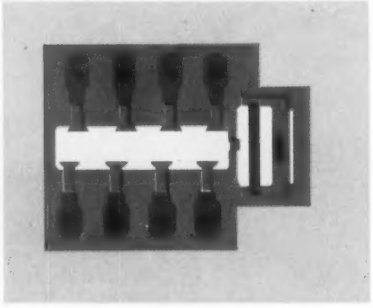
5. Can machine mounted coolers and interstage piping be factory pre-fitted?

Ans: Yes. In fact, when overhead mounted piping and coolers are furnished by Worthington, such piping and coolers are always completely assembled and fitted to the compressor before it leaves the factory.



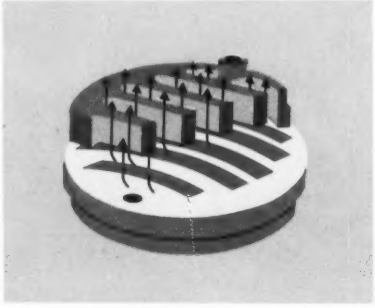
6. Why is the balanced opposed compressor easier to install than other types of equivalent size?

Ans: Semi-packaged design. Self aligning features permit easy and sure crankshaft, frame, and motor alignment on simplified foundation. Pre-fitted coolers and piping eliminate many problems associated with multi-stage compressor installation.



7. Is it common practice to install more than one compressor service on a single multi-cylinder frame?

Ans: Yes. Particularly where the compression services are related, as in chemical plants. The arrangement results in substantial savings in initial plant cost.

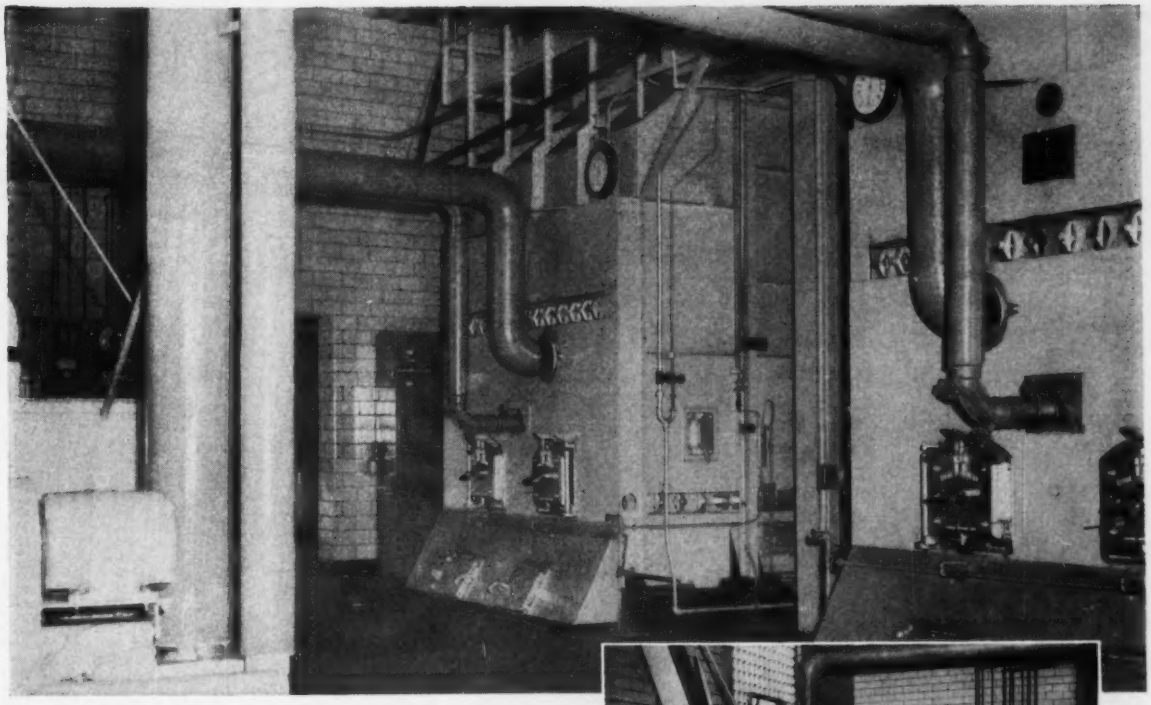


8. Industry's most preferred compressor valve is standard with Worthington. It is:

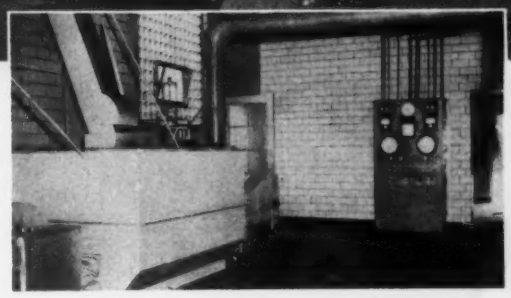
Ans: Feather Valve! By actual count of 2 to 1, this outstanding compressor valve is preferred by operators and engineers.

SCORING: If you got 7 or 8 questions right you're up-to-date on balanced opposed compressors and you recognize the value of the Worthington machine. If you got 5 or 6 right you're acquainted with some of the benefits of Worthington equipment, but you need brushing up. If you got less than 5 right, get in touch with your nearest Worthington technical representative. He'll give you the full story on the many advantages of the Worthington design. Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ont. 36.5

WORTHINGTON



Two Iron Fireman Pneumatic Spreader stokers with B & W water tube boilers are shown in operation at the Palmyra, Ohio plant of Universal Sewer Pipe Co. "This is our fifth plant," said John Satow, secretary, "to be equipped with Iron Fireman stokers. We started using Iron Fireman equipment about 25 years ago and have been very pleased with the operation and dependability of all installations." The company uses the stoker-boilers to furnish process steam for the manufacture of terra cotta pipe.



Coal hopper and control panel for the Palmyra, Ohio plant installation. Coal of almost any grade from lignite to the best bituminous in sizes from ¼" slack to 2" top size is fed from these bins. Air is automatically adjusted to fuel feed rate and condition of the fuel bed, maintaining a clean, efficient fire.

Don't overlook the advantages of AUTOMATIC COAL FIRING

What are these advantages?

1. In many areas coal is the most economical source of heat, producing from 15 to 50 per cent more heat per dollar than other fuels.

2. Iron Fireman stokers convey, dry, pre-heat and precisely meter low cost, small size coals of almost any grade. They convey the fuel from sealed bins directly to the fire, without additional handling.

3. Automatic controls accurately pace the fire to the load, keeping fuel and air in perfect balance.

You will be pleased at the precision, cleanliness and economy of modern Iron Fireman coal firing techniques. Not only do these automatic stokers cut hand labor, but they operate with such high efficiency that they will fire even the lowest and cheapest grades of coal—grades that are not suitable for hand firing.

For up-to-date information on modern Iron Fireman coal firing, please mail the coupon.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT FOR HEATING, PROCESSING, POWER

IRON FIREMAN MANUFACTURING CO.
3133 West 106th Street, Cleveland 11, Ohio
(In Canada write to 80 Ward Street, Toronto, Ontario)

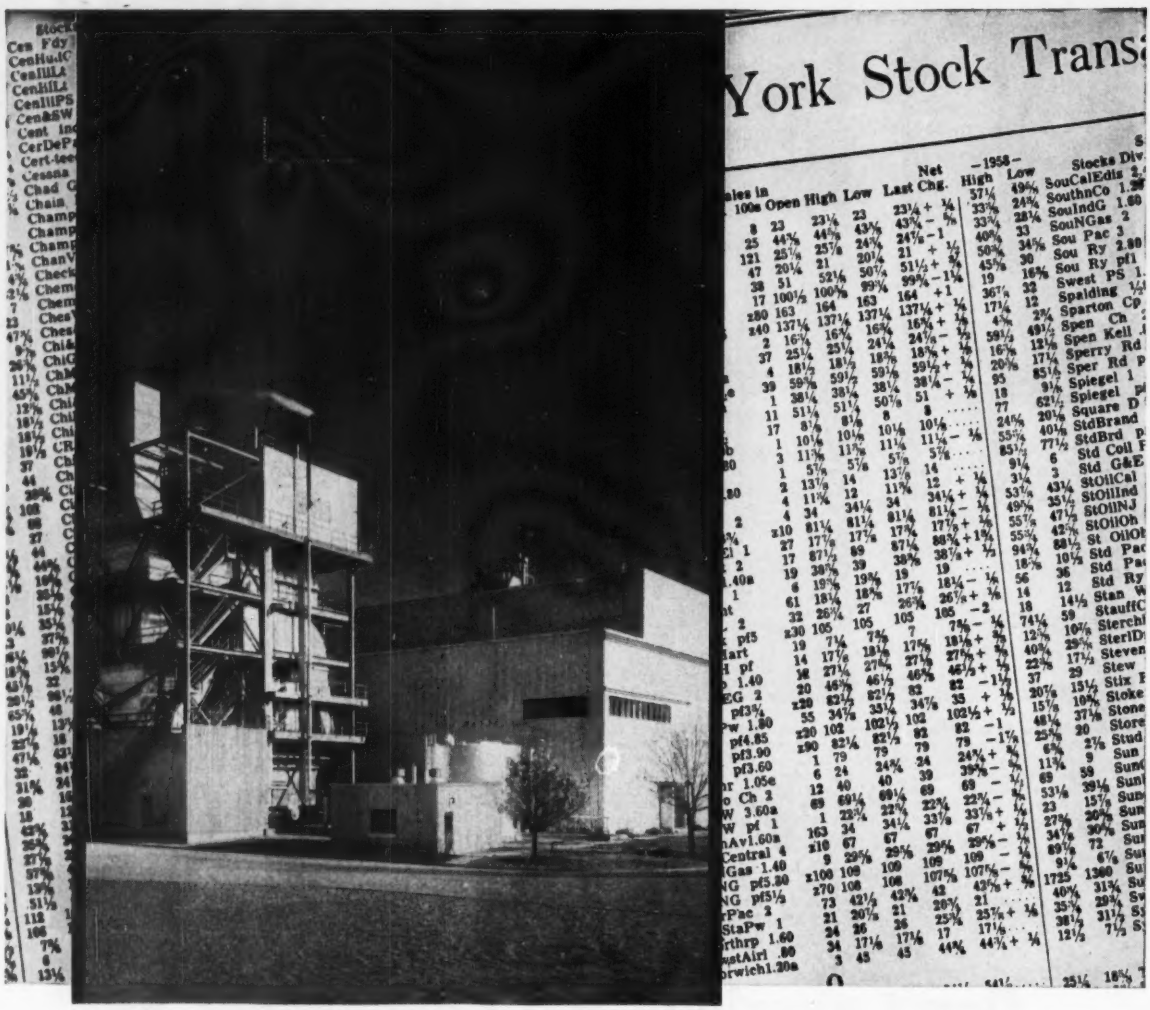
Please send me more information on Iron Fireman commercial and industrial stokers.

Name _____

Address _____

City _____ Zone ____ State _____

For more facts circle 221 on Reader Service card, p 121



50,000 kilowatt central station built for Southwestern Public Service Company.

Solving the paradox of power plant construction through Pritchard's GOOD FINANCIAL DESIGN

How much should you invest in power facilities? This question has a double-edged answer. If you aim for lowest plant cost, the result can be poor efficiency and high operating costs. On the other hand, building for the best heat rate can run costs so high that the completed plant may not earn a reasonable return on invested capital.

Building power plants that offer the best solution to this kind of problem is a Pritchard specialty. All of Pritchard's services—ranging from economic studies, engineering and construction, to delivery of a turn-key plant—are focused on good financial design that balances operating costs against capital investment. Examples of Pritchard's skill in striking this economic "balance" point can be found in many power installations over the country.

When you are confronted with the paradox of power plant construction, let Pritchard help you get the most advantageous solution. Pritchard is staffed to submit a turn-key proposal – or can supply design, engineering or construction services separately.

PROFITABLE FACILITIES THROUGH GOOD FINANCIAL DESIGN

J.F. **Pritchard** & Co.

ENGINEERS • CONSTRUCTORS

Dept. 408, 4625 Roanoke Parkway, Kansas City 12, Mo.

OFFICES IN CHICAGO, HOUSTON, PITTSBURGH, NEW YORK

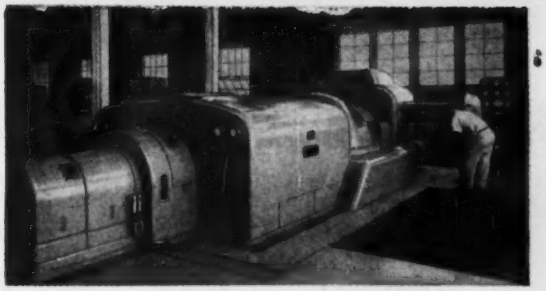
SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

For more facts circle 222 on Reader Service card, p 121

circle 223 on Reader Service card, p 121 ➤

One reason why Fairfield, Illinois has efficient electric service—

Nonpareil Turbine Oil



Plant superintendent James Easton and Standard Oil industrial lubrication specialist Charlie Brown inspect 5,000 kw. Worthington turbine, one of four turbines in Fairfield Municipal Light & Power Company plant lubricated with NONPAREIL Turbine Oil.

These turbine installations trace the record of growth in electric power consumption in Fairfield, Illinois, over the past 19 years:

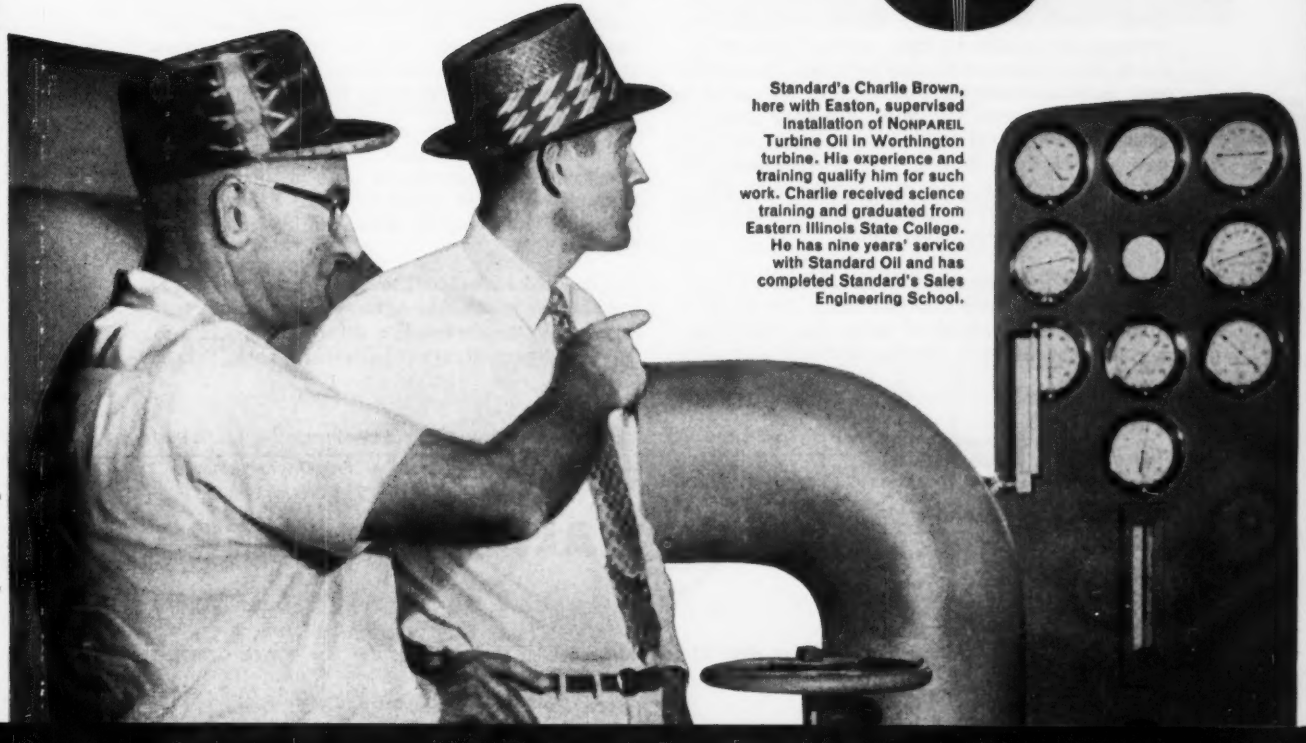
Type	Turbine Cap.	Installed
Westinghouse	1,500 kw.	March, 1940
Westinghouse	2,500 kw.	March, 1942
Westinghouse	4,000 kw.	March, 1949
Worthington	5,000 kw.	July, 1957

When the first turbine went into service, Fairfield Power plant management decided upon a turbine lubricant they felt would be dependable—NONPAREIL Turbine Oil. Standard Oil, they found, would give them concrete evidence of the oil's dependability. They received a certificate guaranteeing that, for the life of the turbine, the acidity of the oil would never exceed 0.15 mg. KOH/g. Indeed, through the years the oil has remained at a much lower acidity level, usually in the order of 0.06 mg. KOH/g. Periodic analysis of the oil in Standard's Whiting laboratory confirms that the oil is performing according to guarantee.

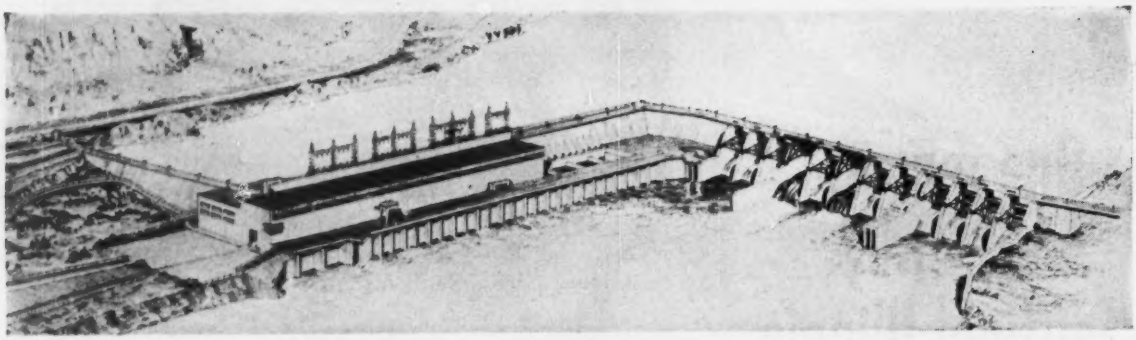
The kind of service Fairfield Municipal Light & Power gets from NONPAREIL Turbine Oil comes about this way: NONPAREIL is the subject of special refining techniques and handling. A special crude is used as a base stock. All sludge-forming compounds are removed. An oxidation inhibitor which permanently controls acidity is added. No sweetening or resting of NONPAREIL Turbine Oil is required at any time.

Men with experience in turbine lubrication can give you more facts about NONPAREIL Turbine Oil. Call your nearby Standard Oil office in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*



Standard's Charlie Brown, here with Easton, supervised installation of NONPAREIL Turbine Oil in Worthington turbine. His experience and training qualify him for such work. Charlie received science training and graduated from Eastern Illinois State College. He has nine years' service with Standard Oil and has completed Standard's Sales Engineering School.

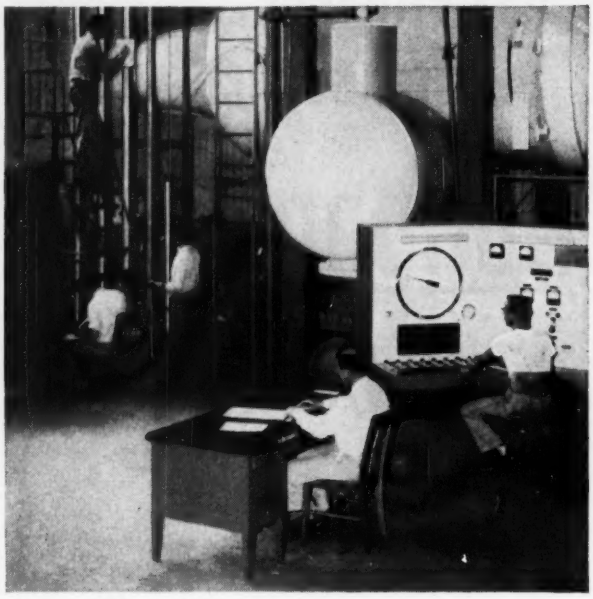


Rocky Reach Hydroelectric Project, under construction on the Columbia River by Public Utility District No. 1 of Chelan County, Washington. Stone & Webster Engineering Corp. are Engineers and Supervisors of Construction. The installation is downstream from Chief Joseph Power Project, where six 100,000 HP vertical Allis-Chalmers Francis units are installed.

Homologous models for Rocky Reach were tested in the York Works Hydraulic Laboratory under controlled conditions that duplicate those in protoype field installations.

ROCKY REACH TO USE ALLIS-CHALMERS KAPLAN TURBINES

High-capacity units to be equipped with special new Runaway Speed Limiter



Rocky Reach Hydroelectric Project, scheduled to generate electricity in 1961, will be powered by seven Allis-Chalmers Kaplan turbines. These 280-inch units are each rated at 140,000 HP under a 92-foot head, with maximum expected capacity exceeding 160,000 HP under a 98-foot head. This new high-capacity design, with greatly improved cavitation characteristics, was developed by Allis-Chalmers engineers at the York Works and tested in the high head test stand there.

Each unit will be equipped with a special new turbine Runaway Speed Limiter, which will make it impossible for a speed of more than 85% over normal to be attained. The possibility of excessive overspeeds of 150-200%, previously an accepted characteristic of Kaplan-type turbines, is positively eliminated. A substantial saving in the cost of generators resulted from this new method of speed limitation.

Its feasibility was proved by laboratory and field research. Field acceptance tests on installations equipped with the Runaway Speed Limiter have confirmed its complete dependability and effectiveness.

You can look to A-C for the latest design, engineering and manufacturing advances in hydraulic turbines and accessories. For information, write to Allis-Chalmers, Hydraulic Division, York, Penna.

Hydraulic Division RESEARCH DESIGN HYDRODYNAMICS ENGINEERING FABRICATION

Hydraulic Turbines & Accessories • Pump-Turbines • Pumps • Liquid Heaters

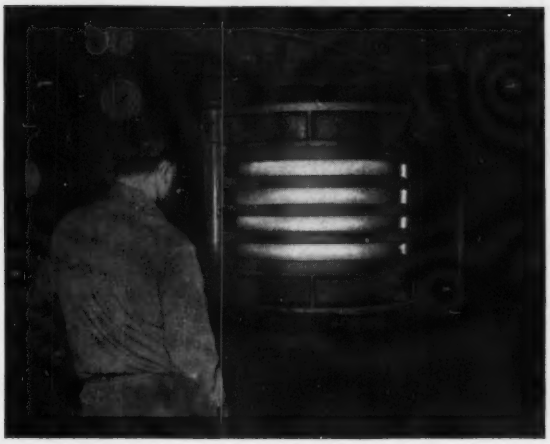
Rotovalves • Ball Valves • Butterfly Valves • Free-Discharge Valves

ALLIS-CHALMERS

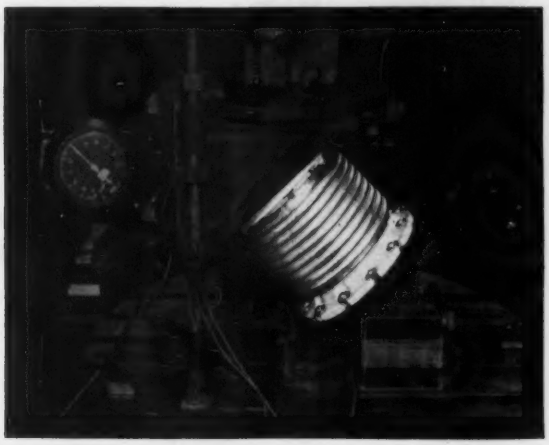
1100

For more facts circle 224 on Reader Service card, p 121

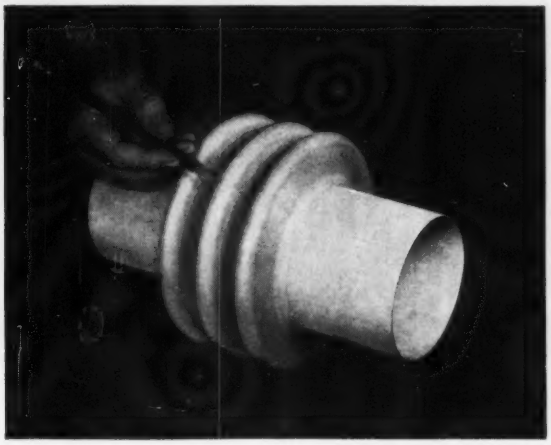
4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.



3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

For more facts circle 225 on Reader Service card, p 121

Super 70's "On Stream"

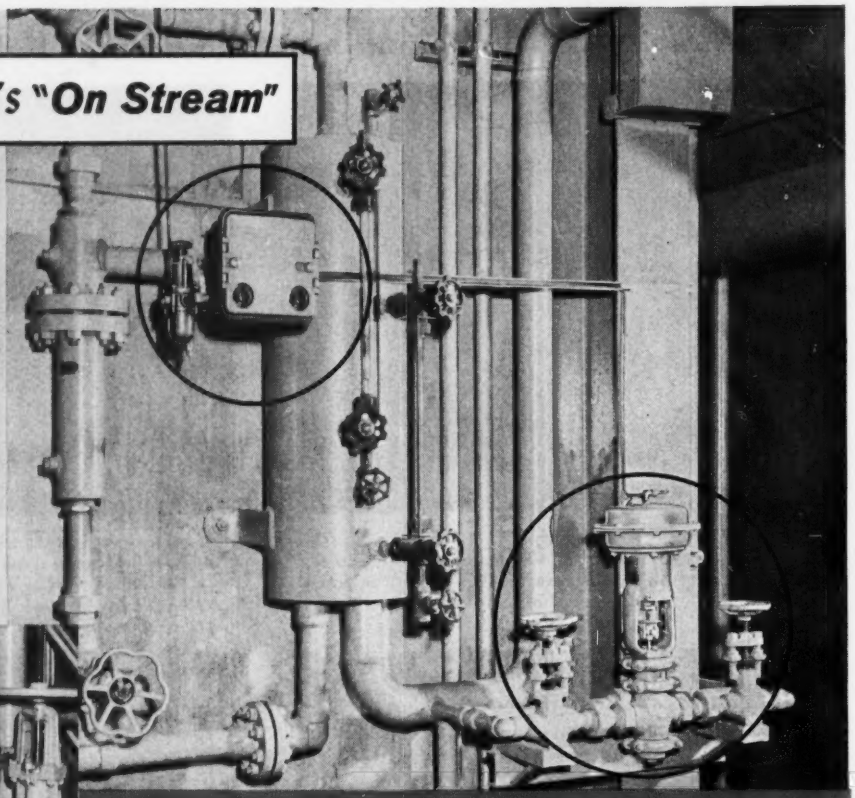


Photo at right shows a turbine gland exhauster level control system with BS&B Level Control and Super 70 Control Valve.

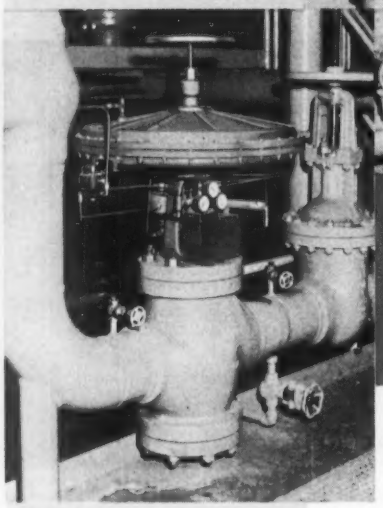


Photo above shows a BS&B pressure-balanced deaerator level control valve, complete with valve positioner, reverse acting relay and booster relays.

BS&B CONTROLS . . . "On The Job" At Conesville!

Conesville No. 2, one of two new 125,000 KW steam-electric generating units for Columbus and Southern Ohio Electric Company, is now "on the line" at Conesville, Ohio.

BS&B Controls make up an important part of the controls system of this plant, with Super 70 Control Valves installed in Heater Drain, Steam Reducing and Water Supply Services. BS&B Level, Pressure and Temperature Controllers also play an important role in this plant's automatic operation.

Conesville No. 1, a "sister" unit now under construction for C and SOE, is similarly equipped with BS&B Controls and will go into service sometime early this year. BS&B personnel worked closely with the staffs of C and SOE, and Ebasco Services Incorporated, Engineers and Constructors, in the design, application and operation of these control systems.

Next time you have a new station "on the boards," specify BS&B Controls right down the line. They're dependable, efficient, and cut down maintenance costs. You'll get application engineering assistance, too!

SUPER BS&B 70

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q9

7500 East 12th Street Kansas City 26, Missouri

PEERLESS PUMPS

GET THAT BETTER PUMP FOR YOUR NEW BUILDING

Why the AquaLine® for your job?

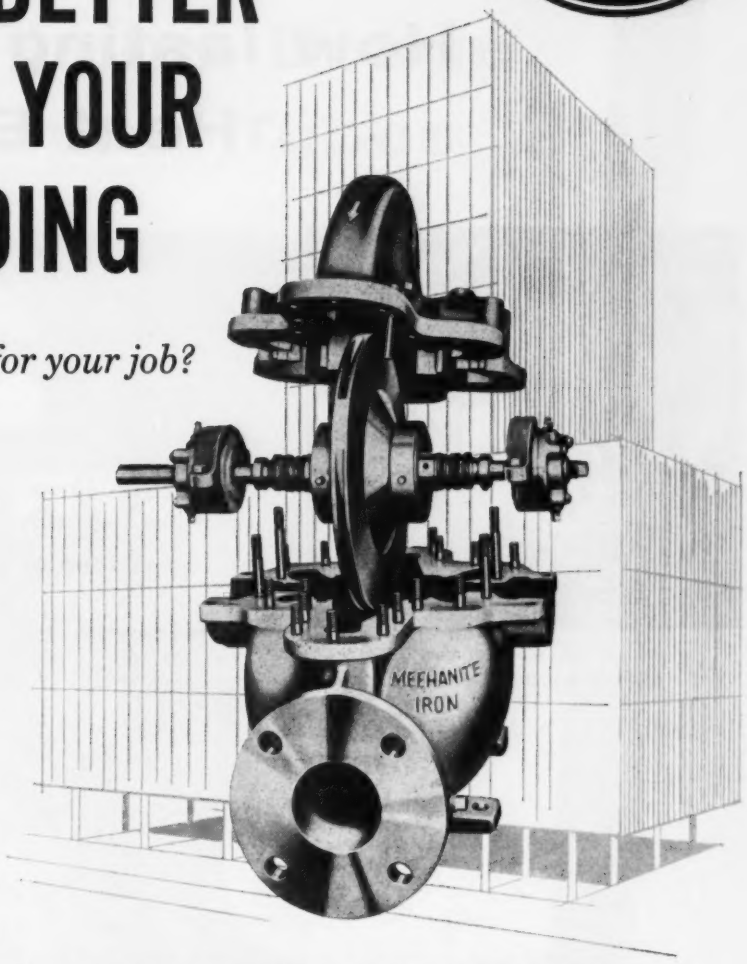
Fast, Easy Installation—Peerless AquaLine pumps install quickly in new or existing systems. No special tools are required. Take it out of the package and put it to work.

Compact, Space Saving — Sealed type AquaLines require only one-half the space of other type pumps. Even the packed types are streamline and compact, permitting efficient space-saving layouts.

Easy to Maintain—AquaLine's horizontal split-case design affords quick inspection of rotating parts without disturbing piping. Parts lift out for easy replacement, materially reducing down time.

Immediate Availability—All sizes of pumps and parts are stocked for rapid delivery. You get the pump you want when you need it—ready to unpack and install.

Low in Cost, High in Quality—Peerless AquaLine pumps are engineered with the same high-quality traditionally found only in more expensive units. Yet this pump is priced right. Get the facts. Send for Bulletin B-2100 today.



FOR EFFICIENT DEPENDABLE WATER HANDLING SPECIFY THE NEW PEERLESS AquaLine® PUMP

AquaLine Characteristics:

Sizes: to 8 inches **Capacities: to 2600 gpm**
Heads: to 280 feet **Temperatures: to 250° F**

ATTENTION DEALERS: A few choice dealerships are available for the Peerless AquaLine Pump. Write us for more details.

Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Peerless Pump Division

Offices:
New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.
Distributors in principal cities.
Consult your telephone directory.

PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION
2005 Northwestern Avenue, Indianapolis 8, Indiana
Please send me Bulletin B-2100.

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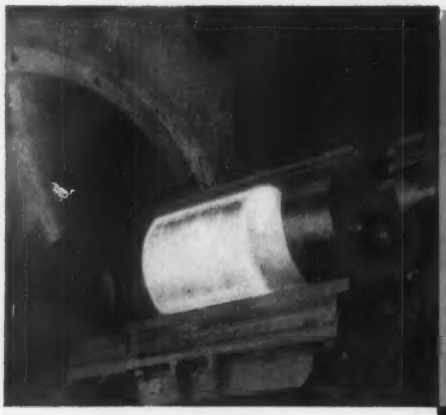
Address_____
City_____
State_____

For more facts circle 227 on Reader Service card, p 121

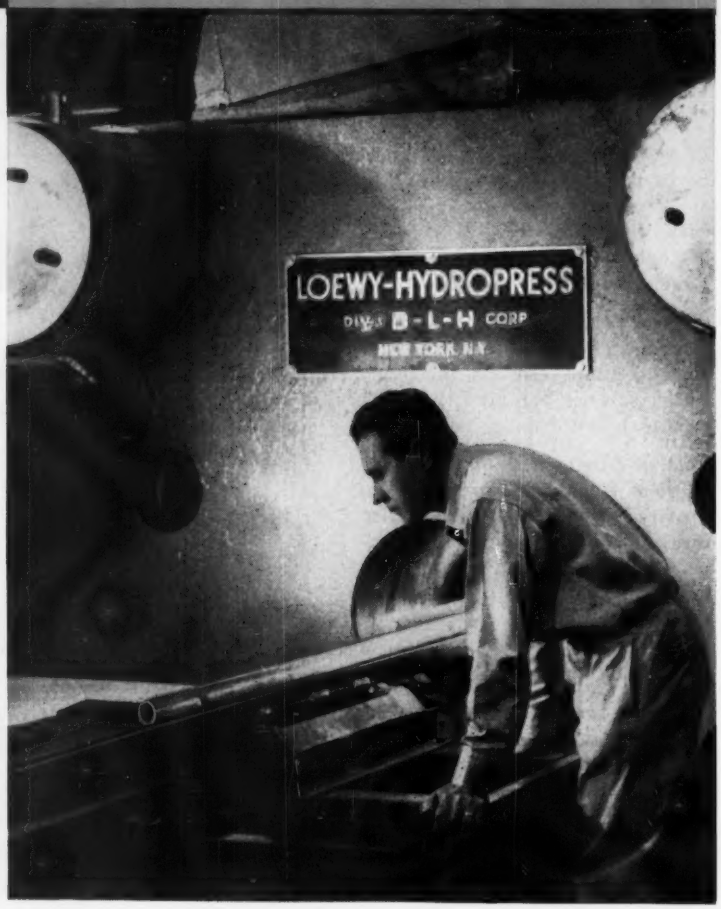
How lasting quality is Heat Exchanger



Heated billet ready for insertion into extrusion press.

2 EXTRUDING

(SECOND OF A FIVE-PART SERIES)



Billet emerges from extrusion press as a heavy-walled tube, or shell.

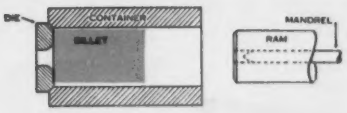
built into Phelps Dodge and Condenser Tubes...

Phelps Dodge heat exchanger and condenser tubes are formed from billets by the hot-forged extrusion process, a method that produces sturdy, seamless tubes with long service life, finest properties and precise dimensions.

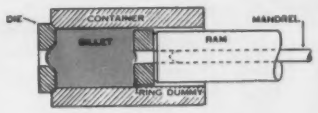
The metal billet, before being placed within the container of the extrusion press, is first heated in a controlled atmosphere to a temperature predetermined for each specific alloy. The subsequent forging (upsetting) and extruding operations are combined in a simultaneous operation.

The billet is forged by a compression system using several million pounds of hydraulic pressure. This operation refines the grain and achieves maximum densification of the billet. Finally, a highly polished steel mandrel is used to pierce the billet, thus forcing extrusion of the metal over and around the mandrel and through a steel die into the form of a heavy wall tube.

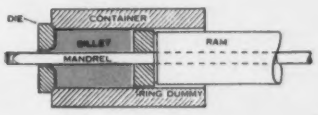
Throughout the entire tube fabricating operation—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.



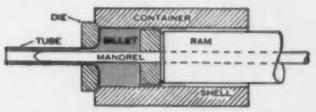
Billet is placed within container for forging operation.



Heated billet is forged within container through action of the ram pressing on the ring dummy-block.



Steel mandrel pierces billet just before extrusion takes place.



Hydraulic pressure exerted on ram and ring dummy-block causes metal to flow over mandrel and through die.

PHELPS DODGE COPPER PRODUCTS CORPORATION

First for Lasting Quality—from Mine to Market!

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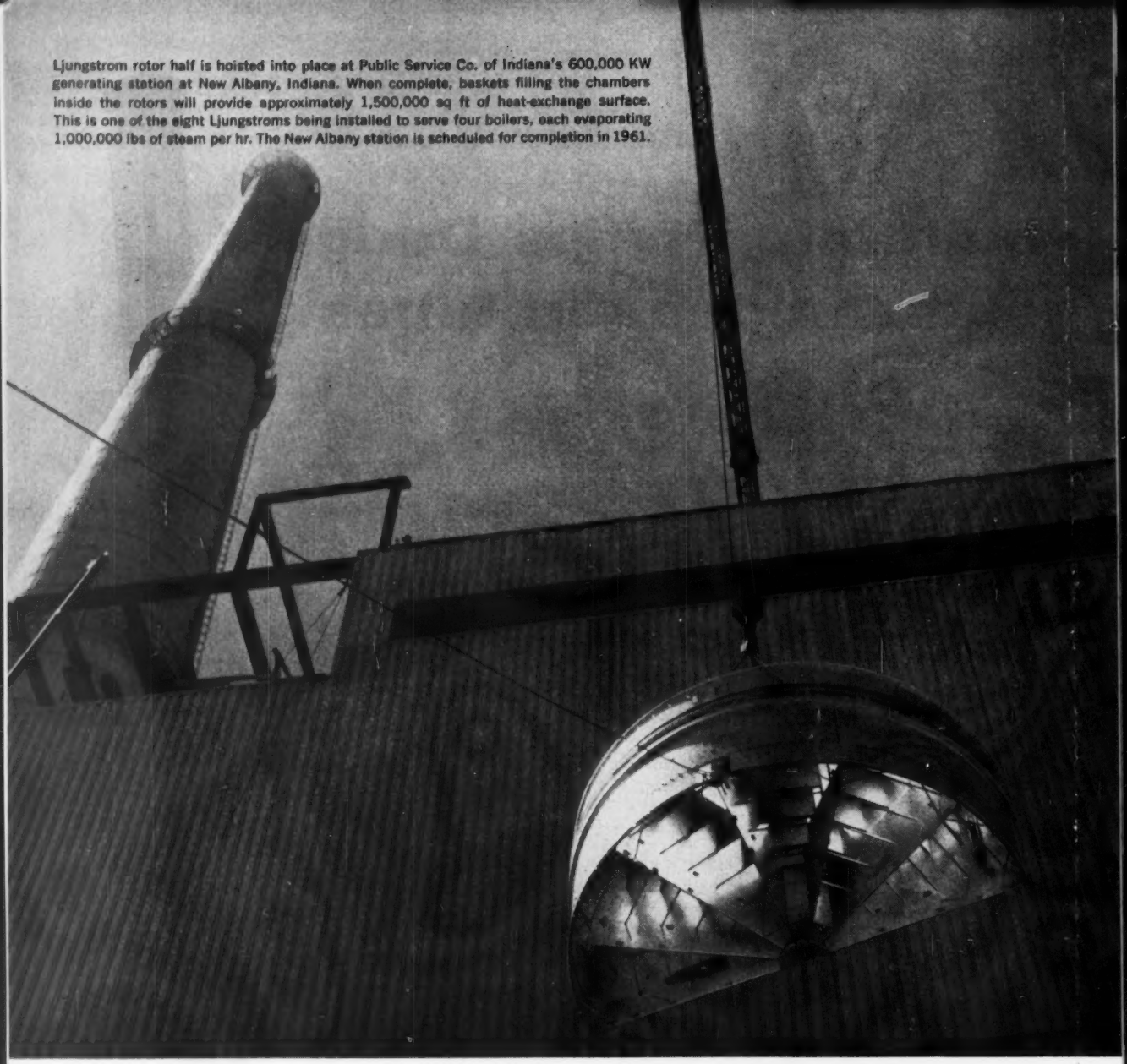
For more facts circle 228 on Reader Service card, p 121



Ljungstrom rotor half is hoisted into place at Public Service Co. of Indiana's 600,000 KW generating station at New Albany, Indiana. When complete, baskets filling the chambers inside the rotors will provide approximately 1,500,000 sq ft of heat-exchange surface. This is one of the eight Ljungstroms being installed to serve four boilers, each evaporating 1,000,000 lbs of steam per hr. The New Albany station is scheduled for completion in 1961.

BEHIND NEW ALBANY'S **LJUNGSTROMS®** —**LIFETIME AIR PREHEATER SERVICE**

One of the major reasons why Public Service Co. of Indiana, Inc., chose Ljungstrom for its new generating station at New Albany is Lifetime Air Preheater Service.

Lifetime Air Preheater Service means that Ljungstrom engineers make regular calls *throughout the life of each unit.* They check to make sure your Ljungstroms are working at top efficiency, and that they'll continue to work that way. This service policy covers all Ljungstroms—right from the very first installation made in 1923.

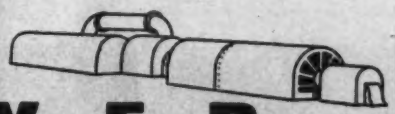
But that's not all. Air Preheater provides first-rate *emergency* service, too. For instance, a Ljungstrom customer in the southwestern U.S. recently called on a Wednesday night for replacement parts. Air Transport looked like the fastest way, but schedules indicated a minimum three-day delivery time. So Air Preheater loaded the parts on a pickup truck, and their men drove them more than 1,000 miles to their destination...34 hours straight driving. The parts were installed and in service by Friday morning.

Fast response to emergencies and regular inspection of Ljungstrom installations are two of the many advantages Air Preheater provides. Another is expert knowledge of boiler and preheater problems gained from over 35 years' experience. Perhaps these reasons explain why 9 out of 10 preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

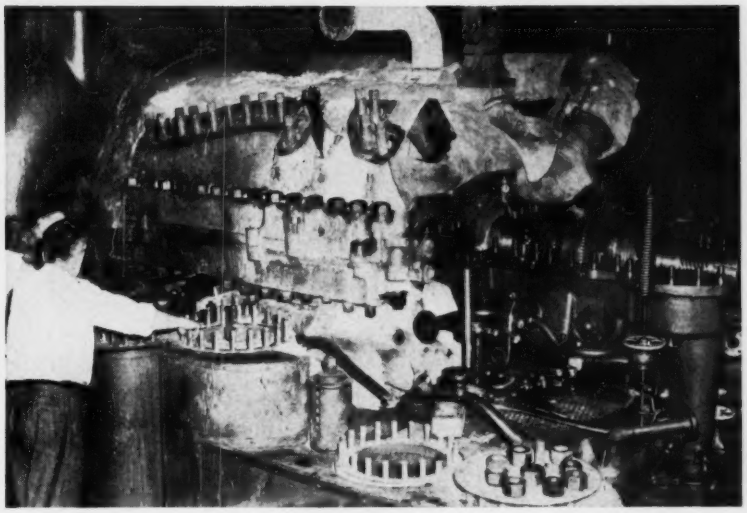
MOLYKOTE®
LUBRICANT



POWER NEWS

PRACTICALLY 100% PROTECTION AGAINST THE GALLING AND SEIZING OF ALL HIGH TEMPERATURE THREADED CONNECTIONS

MOLYKOTE TYPE G IS BEST THREAD LUBRICANT AVAILABLE



Hundreds of threaded connections in a turbine are subjected to temperatures which may go as high as 1100°F.

Every power engineer realizes that the extreme bearing pressure in a threaded connection is carried at a series of contact points on the mating surfaces of the threads. The number of these contact points increases with load. Since these contact points are not spaced symmetrically about the thread circumference, off-center loads increase the severity of the contact pressures and frictional conditions.

Liquid lubricants are ineffective under these load conditions and seizing and galling often occur when make-up or break-away torque is applied.

MOLYKOTE exhibits the lowest coefficient of friction of all solids at extreme bearing pressures and offers the highest resistance against galling and seizing. Because of its strong affinity for attachment to metal, it cannot be wiped off. MOLYKOTE used in threaded connections remains effective at temperatures in excess of 1100°F. The saving in damage to threaded connections in the power industry runs into fantastic figures.

When writing, refer to Item 510

MOLYKOTE TYPE Z UNAFFECTED BY RADIATION

Used in Critical Areas of Latest Nuclear Power Plants for Lifetime Lubrication

The nuclear power plant has complicated lubrication problems. Not only must lubricants operate over a wide temperature range, but they must be unaffected by radiation and, in many cases, must provide lifetime lubrication because of the inaccessibility of parts and the danger involved in servicing reactors.

More than a decade ago, scientists working for the Atomic Energy Commission discovered that MOLYKOTE Type Z was unaffected by radiation and they used it to lubricate equipment subjected to intense radiation. During the development and testing of nuclear power plants for atomic submarines, MOLYKOTE Type Z was specified by the designers and used extensively.

Today, more than ever, with the development of atomic reactors for the power industry, more emphasis is being placed upon the vital quality of lifetime lubrication and MOLYKOTE is being called upon to play a part which is continually increasing in importance.

When writing, refer to Item 509

MOLYKOTE TYPE Z REDUCES SERVICING OF EQUIPMENT

MOLYKOTE Type Z powder is being used on timing devices, Variacs, rheostats, knife switches and circuit breakers where conventional lubricants gather dust or tend to become gummy.

In many applications it has been noticed that pitting and oxidation of contact points was considerably reduced after MOLYKOTE Type Z was applied. Countless man-hours are saved in cleaning, adjusting and lubricating electrical contacts and relays.

When writing, refer to Item 512

Address your letter to The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.
Phone: FIreside 8-3724.

LEADING POWER EQUIPMENT MANUFACTURERS SPECIFY MOLYKOTE FOR MACHINERY WEAR-IN

Leading power equipment builders have found after years of experience that the use of MOLYKOTE Lubricants is their best guarantee against breaking-in damage. Costly service calls to refinish damaged parts have been eliminated. During reassembly, after overhaul, MOLYKOTE WEAR-IN COMPOUND provides the same basic guarantee of dependable service.

When writing, refer to Item 511

REPRINT AVAILABLE

"SOLID LUBRICANTS . . ." *an 8-page reprint from the Nov. 1958 issue of POWER, is available until supply is exhausted.*

SEE OUR CATALOG IN SWEET'S PRODUCT DESIGN FILE

THE ALPHA-MOLYKOTE CORP.
Stamford, Connecticut
Please send me details on

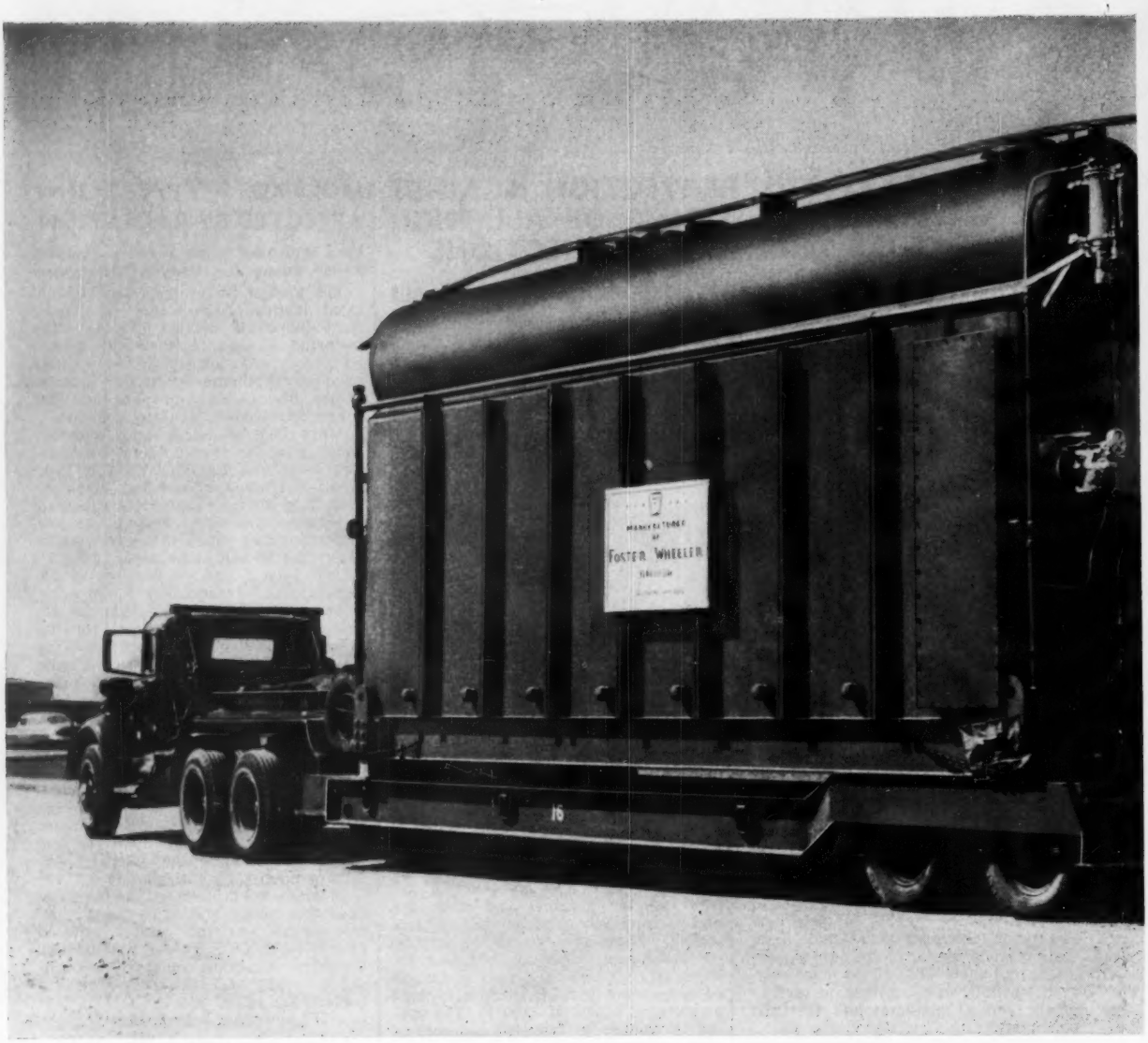
Item 509 ☐	Item 511 ☐
Item 510 ☐	Item 512 ☐

Name _____
Company _____
Address _____
City _____
State _____

THE ALPHA-MOLYKOTE CORPORATION

BREAKING LUBRICATION BARRIERS

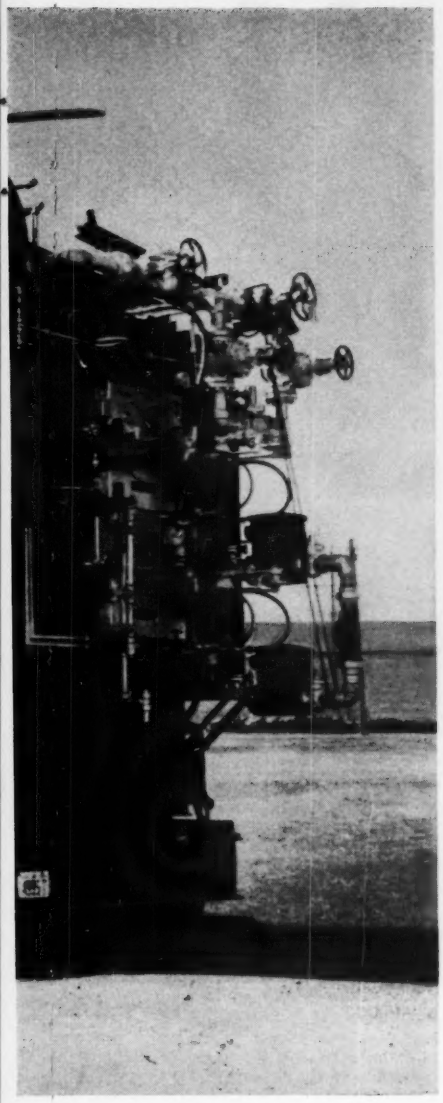
. . . THROUGH RESEARCH



Foster Wheeler Packaged Steam Generator on its way to a refinery, where it is now producing 50,000 lb/hr of high-purity steam for processing and heating purposes.

—PETROLEUM PROCESSING

—CHEMICAL PROCESSING



Foster Wheeler delivers the steam you need and the economy and efficiency you want, in one package

If you need 13,000 lb/hr or more of steam at pressures of 250 psi or above, one of the best ways to begin planning your steam generator installation is by contacting Foster Wheeler right now.

This is Foster Wheeler's record of experience in meeting steam requirements with packaged steam generators.

The first water tube shop-assembled packaged unit was built by Foster Wheeler in 1940, to solve an important defense problem. Today, standard Foster Wheeler Packaged Steam Generators, firing fuel oil and gas separately or in combination, are serving refineries, process and manufacturing plants, hotels, dairies . . . virtually every type of business and industry throughout the world.

Most recent Foster Wheeler development in packaged steam generators is a stoker fired model, the first available to industrial users of steam.

In short, the *heat engineering* experience that goes into Foster Wheeler Packaged Steam Generators is unique in the power industry. And the result is a product engineered for dependable, economical and efficient production of high-purity steam . . . and delivered as a package which keeps installation costs to a minimum.

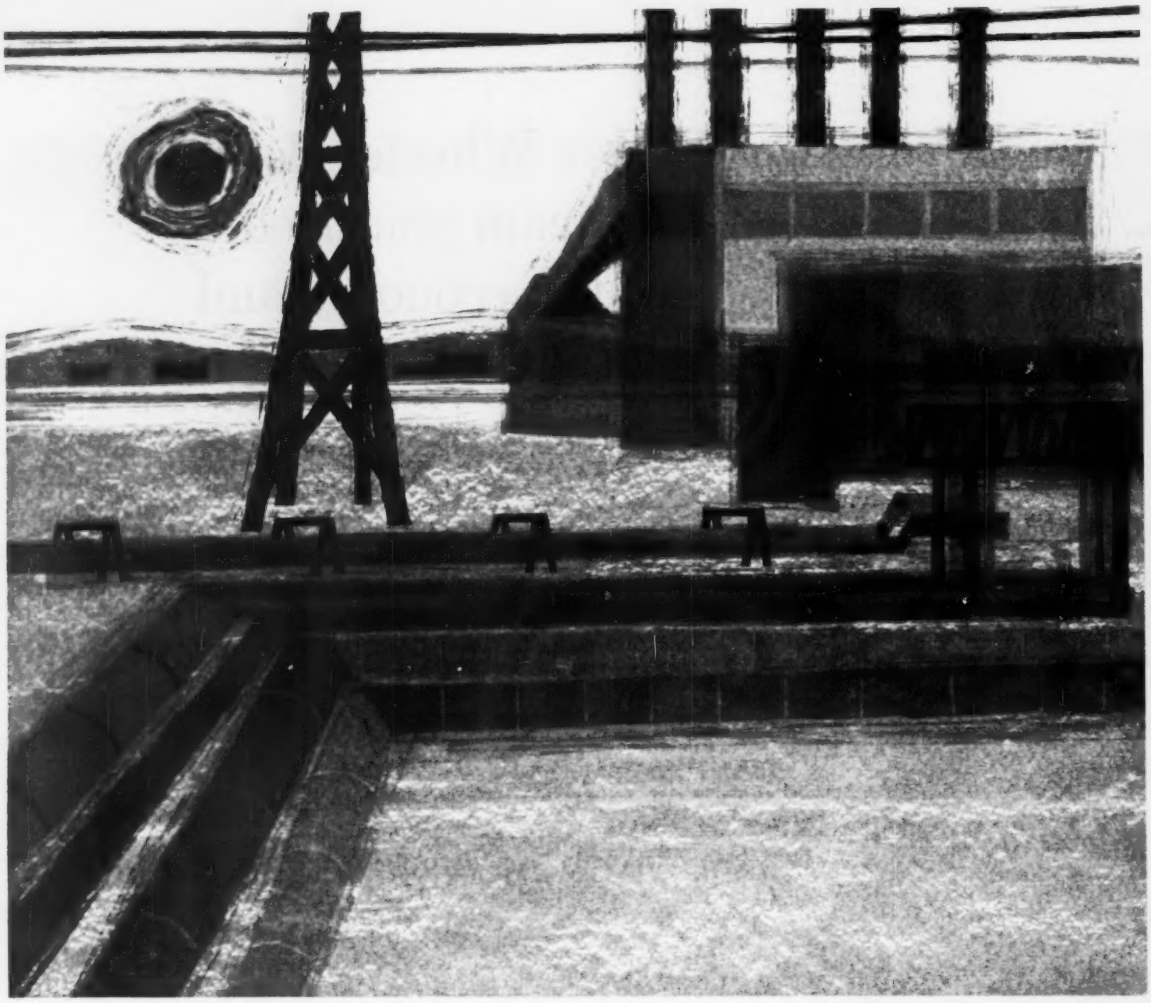
Make planning your steam generator installation easier by getting full information on Foster Wheeler Packaged Steam Generators *before* you start writing your specifications. Write Foster Wheeler Corporation, 666 Fifth Ave., New York 17, for Bulletin PG-58-2. Or better still, contact Foster Wheeler directly and discuss your steam requirements personally with one of Foster Wheeler's *heat engineering* specialists.

Heat Engineered products, plants and processes . . . for the world's power, petroleum and process industries.

—SPECIALIZED INSTALLATIONS

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.



HOW CAN ALUMINUM JACKETING SERVE YOU BETTER AT LESS COST?

You'll find the answer to this, and many other questions concerning aluminum jacketing, in Kaiser Aluminum's free 40-page brochure, "Insulation Jacketing Materials and Methods."

How does the installed cost of aluminum jacketing compare with other insulation finishes? How can dry-wall construction techniques save you labor time and money? What are "snap jackets" and how can they cut installation costs? How do aluminum's advantages of superior corrosion resistance and durability work in your favor, saving you hundreds of dollars over the years?

The answers to these questions can save you money on installed costs and maintenance costs. They're all here—plus full information on aluminum jacketing alloys, fasteners, applications, specifications.

Send for Kaiser Aluminum's "Insulation Jacketing Materials and Methods" brochure now. Mail the coupon!

Kaiser Aluminum construction industry specialists are available to offer immediate engineering assistance on the use of aluminum for insulation jacketing, boiler lagging or other applications in your industry. Contact your nearest Kaiser Aluminum sales office for full information.

KAISER ALUMINUM

Kaiser Aluminum & Chemical Sales, Inc.
Dept. IB-6, 1924 Broadway
Oakland 12, California

Please send me your free brochure, "Insulation Jacketing Materials and Methods."

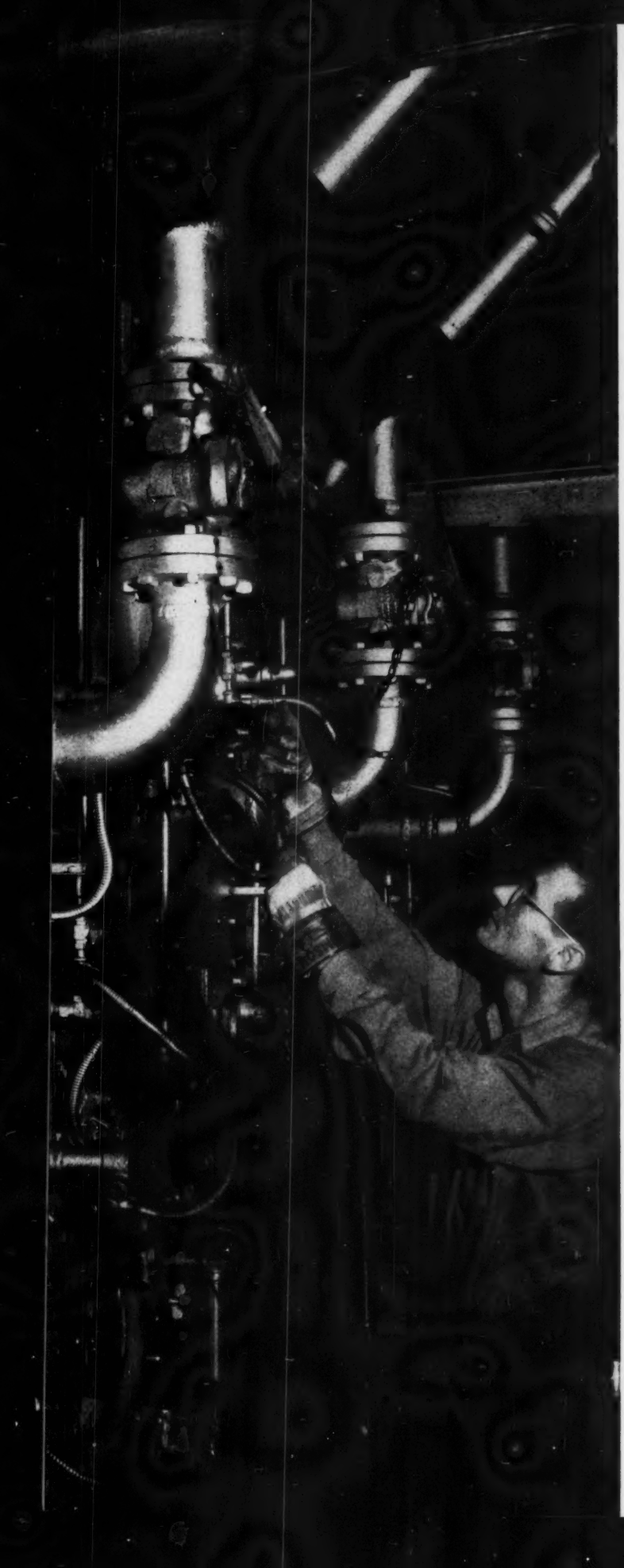
NAME_____

ADDRESS_____

CITY_____ **STATE**_____

For more facts circle 232 on Reader Service card, p 121

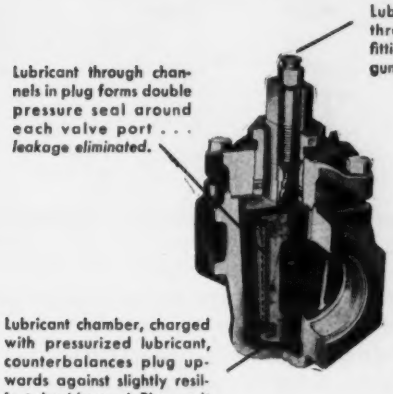
circle 233 on Reader Service card, p 121 ➤



POSITIVE SHUT-OFF ON GAS FUEL LINES?

Most valves can't really hold gas. Rockwell-Nordstrom lubricated plug valves can, and *do* for many power engineers who insist on them where leakage can't be tolerated on gas fuel lines. In the cut-away valve picture below, you'll see heavy red lines on the plug . . . they're the Sealdport® grooves that are charged with *pressurized lubricant* to maintain a double, impenetrable seal against leakage. This lubricant sealing system gives you a tighter seal on gas lines without any of the problems of ordinary metal-to-metal seats. Lubricant sealing can't be scratched, cut or corroded. And you'll save operating dollars by eliminating frequent, costly reseating.

The cutaway valve also illustrates some other important benefits you can expect *only* from lubricated plug valves. Notice the film of lubricant that makes the quarter turn operation smooth and easy; prevents flow control errors. And lubrication *prevents wear*, another reason why these valves stay in service longer, cost less to use than ordinary valves.


Lubricant injected through Rockwell fitting by pressure gun.
Lubricant through channels in plug forms double pressure seal around each valve port . . . *leakage eliminated.*
Lubricant chamber, charged with pressurized lubricant, counterbalances plug upwards against slightly resilient shoulder seal. Plug can't be stuck in seat . . . *instant, dependable operation.*

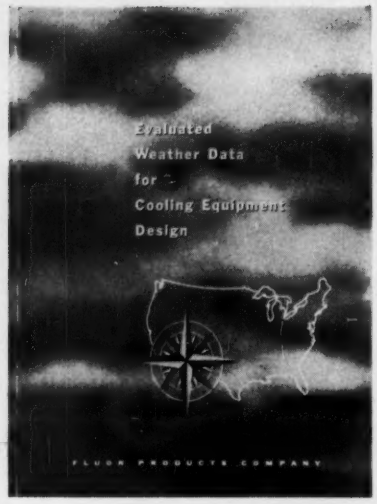
Rockwell-Nordstrom valves, the world's most complete line of lubricated plug valves, cost no more to buy—often less—than ordinary valves. You can get complete details or have a Rockwell Field Engineer visit you by writing: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

another fine product by

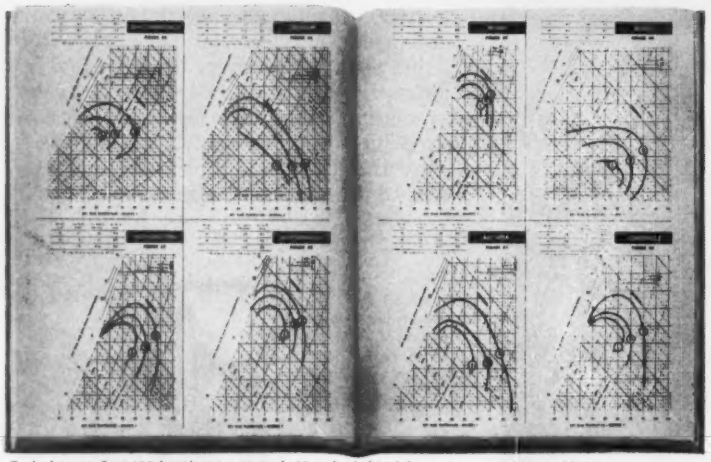
ROCKWELL

Rockwell-Nordstrom lubricated plug valves on gas fuel boiler manifold at large eastern power station.



At last a book that enables accurate specifying of cooling tower needs

EVALUATED WEATHER DATA FOR COOLING EQUIPMENT DESIGN



Typical pages. Over 400 locations are covered. 49 major industrial areas are presented graphically.

This is the most comprehensive and useful compilation of weather data ever published for the user of evaporative heat exchange equipment. It enables engineers in every part of the country to calculate cooling tower requirements correctly. It ends speculation in the sizing of equipment.

From years of cooling tower experience, the Fluor Products Company has realized that compiled weather data — *if truly adequate* — would solve a major problem shared by manufacturer, design engineer and user alike. To achieve this needed scope, Fluor utilized modern electronic data processing techniques to digest and tabulate five to fifteen years of hour-by-hour summer-season observations from over 400 weather stations—a total of 10,000,000 evaluated statistics.

EXAMINE THESE EXAMPLES OF THE BOOK'S VALUE

WET BULB TEMPERATURES

Hourly observations are tabulated for June, July, August and September, a total of 2,928 hours per year per location. Number of hours are tabulated during which wet bulb temperatures equal or exceed any particular value. Also shown are wet bulb temperatures equaled or exceeded by 1%, 5%, 15% and 50% of the total hours of the summer months. The first three frequency levels are also presented in iso-line map form.

COINCIDENT DRY AND WET BULB TEMPERATURES

Coincident presentation is given because the maximums in wet-bulb and dry-bulb temperatures do not occur concurrently in most locations. On psychrometric charts three lines are shown: an "H" line enclosing 99% of total summer hours, an "M" line enclosing 95%, and an "L" line enclosing 85%. The 5-degree dry-bulb range is denoted during which wet bulb extremes are most likely.

WIND DIRECTION AND VELOCITY

Wind coincident with high wet bulb temperature is shown in tabulated and graphic form. It is obvious that wind vitally affects the location and orientation of natural draft cooling towers—but it also affects mechanical draft towers since part of the moist, warm exhaust air may be caused to reenter the tower. Also, three frequencies of both wind direction and velocity are presented.

Other information presented includes influence of adjacent operations, terrain, vegetation, etc., and methods of interpolation between geographical locations and elevations.

A limited number of copies are available for qualified consultants, design engineers, and cooling-tower users. Please make requests on company letterhead and indicate title or position.

FLUOR PRODUCTS COMPANY
BOX 1267B • SANTA ROSA, CALIFORNIA

Fluor PRODUCTS COMPANY

A DIVISION OF THE FLUOR CORPORATION, LTD.

For more facts circle 234 on Reader Service card, p 121

circle 235 on Reader Service card, p 121 ➤

another G-E PROJECT '8000' development

GENERAL ELECTRIC ANNOUNCES . . .

New Custom '8000'* Motors

PROJECT '8000' . . . a major General Electric program of research, redesign, advanced manufacturing and improved customer service on A-c motors 150 to 6000-hp.

*Trademark of General Electric Co.

CUSTOM DESIGNED . . . New General Electric Custom '8000' motors are built specifically to meet your requirements. Selecting from specially designed enclosures, advanced insulation systems, custom-designed end shield and bearing constructions, and more than 15 custom-designed accessories—plus a countless number of electrical designs—General Electric engineers will create a motor to meet exacting needs, provide initial and continuing economy, and give long, reliable service. Turn page for features of new Custom '8000' motors.

NEW CUSTOM '8000' MOTORS GIVE TOP PERFORMANCE WITH LESS MAINTENANCE . . . HERE'S WHY

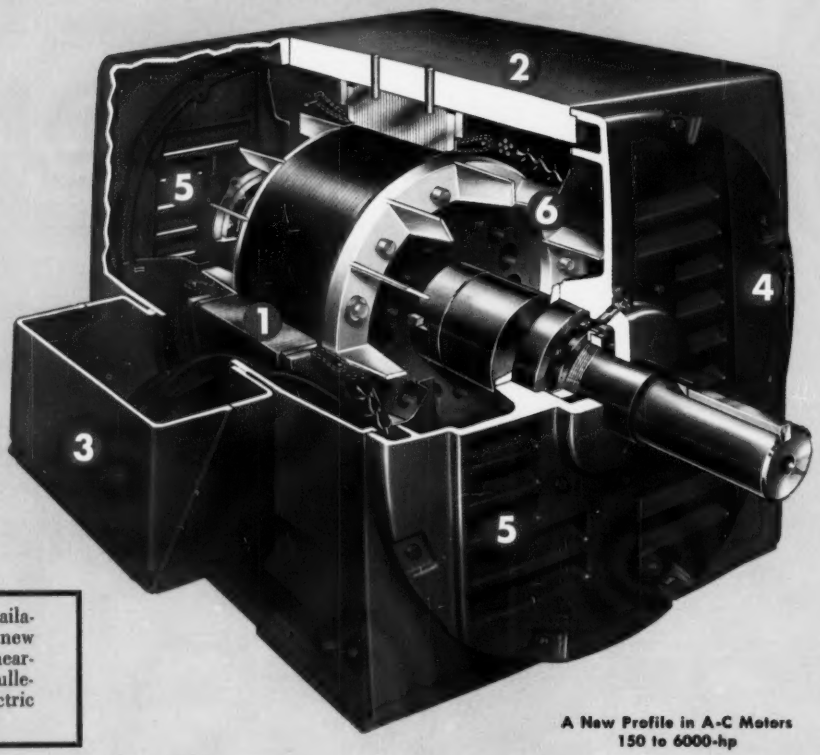
GENERAL ELECTRIC

FROM GENERAL ELECTRIC . . .

another G-E PROJECT '8000' development

NEW Custom '8000'* Motors Give Greater Reliability Require Less Maintenance

1. **LONGER INSULATION LIFE**—Pre-wound core allows closer quality control and gives longer insulation life through improved varnish impregnation or silicone rubber encapsulation.
2. **BETTER CONSTRUCTION**—Cast iron frame withstands 20G simulated transportation shock tests; resists corrosion.
3. **FASTER INSTALLATION**—Conduit box has up to 3 times volume of ordinary boxes; lifting lugs, cast to frame, hold up to 12 times motor weight.
4. **EASIER MAINTENANCE**—Flat end shields are more adaptable to addition of accessories or modifications; are lighter—easily handled by one or two men.
5. **BETTER COOLING**—Double-end ventilation, new duct design and louvred air openings provide more efficient air distribution through motor, reduce hot spots.
6. **LOWER NOISE LEVEL**—Sound power has been cut up to 50% by redesigning frame sections, rotor fans, air deflectors and intakes.



A New Profile in A-C Motors 150 to 6000-hp

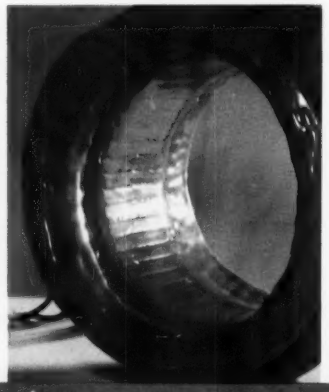
FOR COMPLETE INFORMATION and availability dates about General Electric's new Custom '8000' motor line, contact your nearby Apparatus Sales Office, or write for bulletin GEA-6865, Section 884-2, General Electric Co., Schenectady, N. Y.

NEW *Polyseal** SILICONE RUBBER INSULATION SYSTEM IS AVAILABLE ON CUSTOM '8000' MOTORS

Silicone rubber used in Polyseal insulation systems is a product of General Electric's Silicone Products Dept., Waterford, N. Y. . . . a leader in research, development, and manufacture of silicone materials. Supported silicone tape is a development of General Electric's Insulating Materials Dept., Schenectady, N. Y. Combining silicone rubber with dacron-glass supporting materials is a major engineering advancement, giving this material both the mechanical and dielectric strength required for use as a motor insulation. Polyseal insulation systems are available *only* on General Electric motors. Medium AC Motor & Generator Dept.

FORM-WOUND MOTORS

Polyseal supported silicone rubber insulation system provides greater mechanical, thermal, voltage and environmental endurance than unsupported silicone rubber. Glass fabric materials are imbedded in each layer of silicone tape, which, after coil wrapping is vulcanized under heat and pressure to seal the system against moisture and contaminants. General Electric form-wound open motors with Polyseal insulation system can be used in some severe atmospheres formerly reserved for totally-enclosed motors.



RANDOM-WOUND MOTORS

Polyseal silicone insulation system offers greater flexibility and better heat transfer than existing encapsulations . . . it operates effectively from —90C to 200C and will not crack under excess thermal cycling or severe moisture. After receiving G.E.'s standard random-wound insulation treatments, Polyseal insulation is applied to stator and end turns, completely sealing windings with a thin, waterproof, inert covering which protects against extreme moisture, most chemical fumes, dust and corrosion.

*Trademark of General Electric Co.

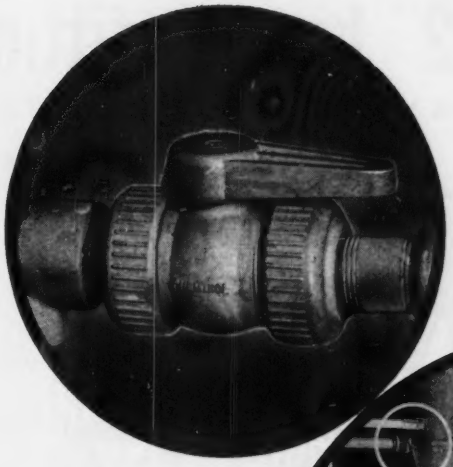
Progress Is Our Most Important Product

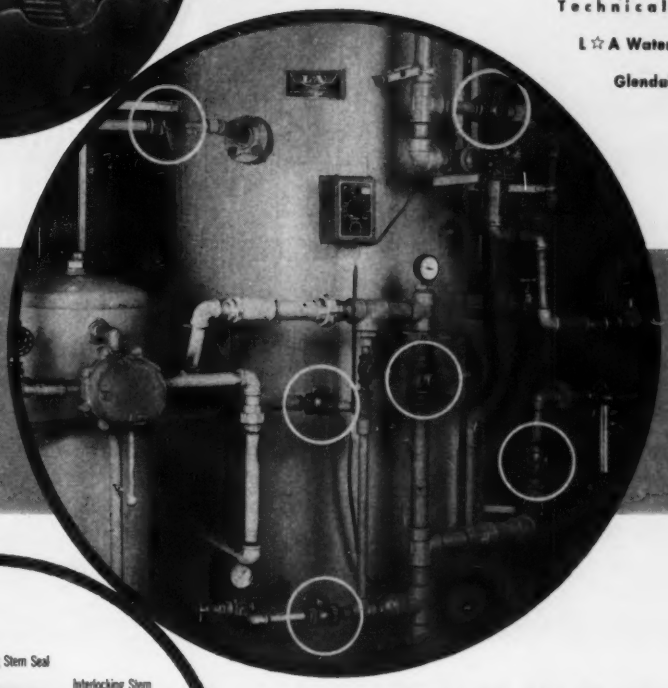
GENERAL ELECTRIC

COMPLETE FLOW CONTROL WITHOUT CORROSION

with CHEMTROL *Plastic Ball Valves!*

says Eugene Schmidt,
Technical Director,
L☆A Water Softener Co.,
Glendale, California.





CHEMTROL plastic ball valves, part of original equipment, on deionizing system at Pioneer Electronics, Los Angeles. Firm rebuilds TV picture tubes. Water purity is essential in preventing screen discoloration.

CHEMTROL PVC BALL VALVES used by L☆A Water Softener Co. are exposed to corrosive effects of sulfuric acid (10%), and caustic soda (4% to 50%). Pressures attain 125 psi. Quick disassembly allows speedy line service in event of obstructions.

OTHER FEATURES: handle indicates valve position from distance — positive shut-off with quarter-turn action. Teflon seats are adjustable, non-sticking. Ball construction assures long life, full flow, non-turbulence. Compact design permits easy adaptation to existing or proposed piping systems.

chemtrol ®

Distributor stocks nationally

CHEMTROL

10872 Stanford Ave.
Lynwood, California
NEVADA, 60837

*CHEMTROL manufactures plastic piping systems equipment for corrosion service. Our complete family of plastic valves includes BALL VALVES, CHECK VALVES, COCK VALVES, METERING NEEDLE and GLOBE VALVES, made from a wide range of plastic materials: PVC types I and II, Kralastic,** Polypropylene, and Penton.* If you are an engineer designing plastic piping systems, send for our new handbook #159.*

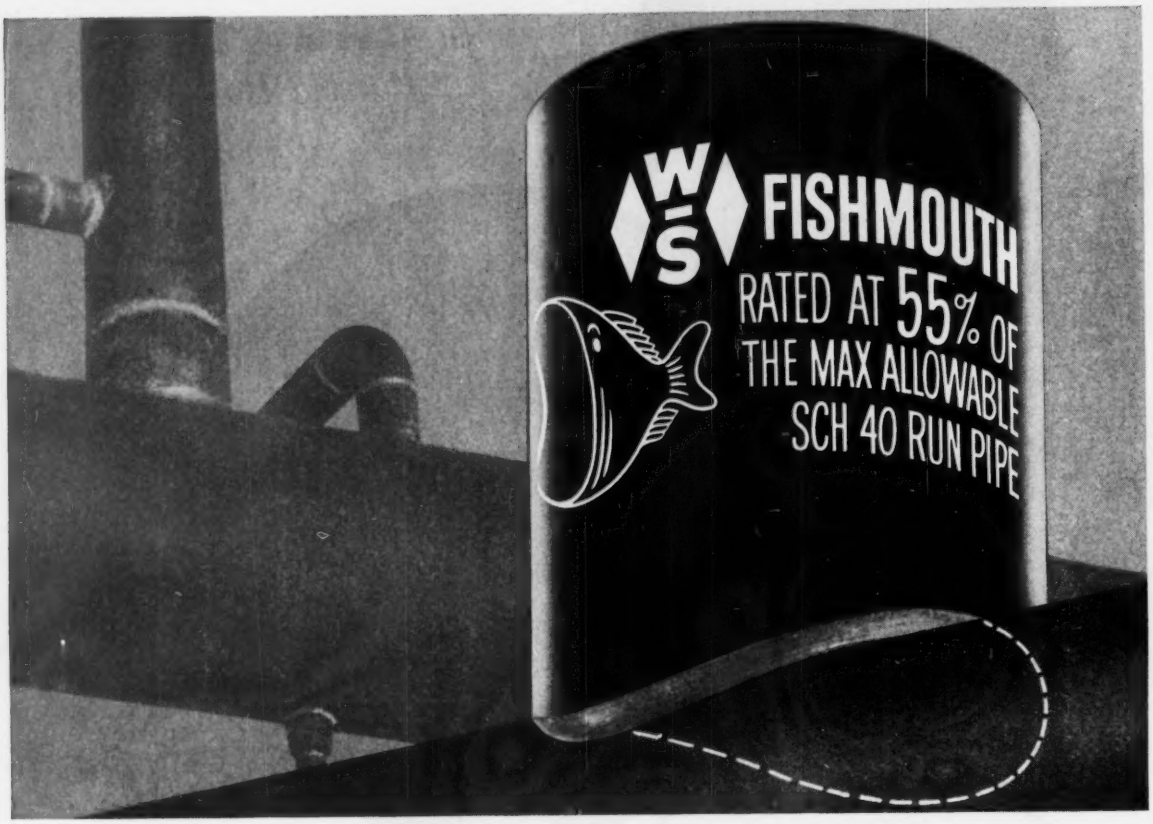
**Hercules Powder Co. **Naugatuck Chemical Co.*

For more facts circle 236 on Reader Service card, p 121

FOR BRANCH CONNECTIONS 2 INCHES OR OVER:

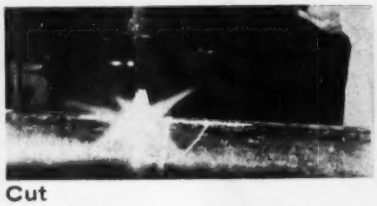
Now! Only 81¢ for a 2″ branch fitting!

THAT'S ALL A NEW, READY-MADE W-S FISHMOUTH COSTS

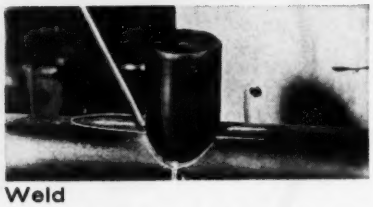


IT'S THE MOST PRACTICAL WAY TO MAKE A BRANCH CONNECTION

Mark



Cut



Weld

The W-S FISHMOUTH saves 50 per cent or more over commercially available branch fittings . . . *costs even less than your own field- or shop-made connection.* Made from Schedule 40 pipe, W-S FISHMOUTH is fully machined and perfectly shaped for strong, leak-proof joints. A ready-made W-S FISHMOUTH is rated for working pressures to 55 per cent of maximum run-pipe limits. Sizes: 2″ to 12″ IPS, butt weld ends. Fewer sizes handle many more jobs, eliminate need for special fittings.

No time or cost required to shape, fit or bevel. Ideal for close-quarter work. Easy access to inspect weld penetration or to back-weld. W-S factory machining means a secure, permanent installation every time.

Ready-made, the W-S FISHMOUTH costs less to buy and install than anything you can buy or make. Write, today, for complete information, prices and names of distributors to: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

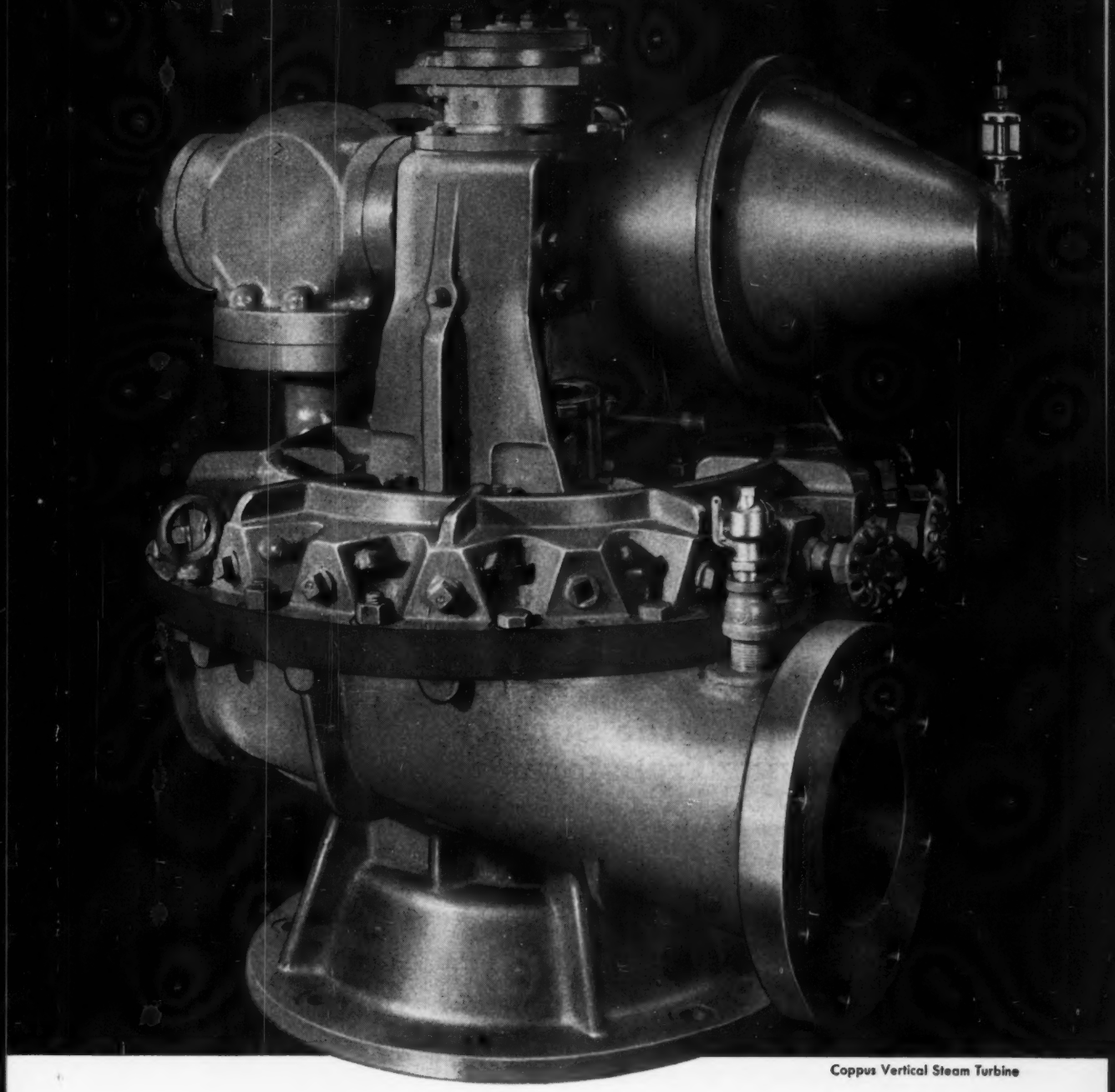
FORGE AND FITTINGS DIVISION PORTER **H.K. PORTER COMPANY, INC.**

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

For more facts circle 237 on Reader Service card, p 121

circle 238 on Reader Service card, p 121 ➤

COPPUS BLUE RIBBON PRODUCTS



Coppus Vertical Steam Turbine

THE MARK OF QUALITY — There's no better test of a turbine's quality than performance. And the new, ruggedly designed, power-packed Coppus Turbines pass all performance tests with top honors! Small wonder. Coppus quality is literally designed and built into them. Their super stamina is the end-product of painstaking craftsmanship, finest materials and methods, thorough testing and control. Each truly deserves its Blue Ribbon . . . assurance of *complete* reliability.

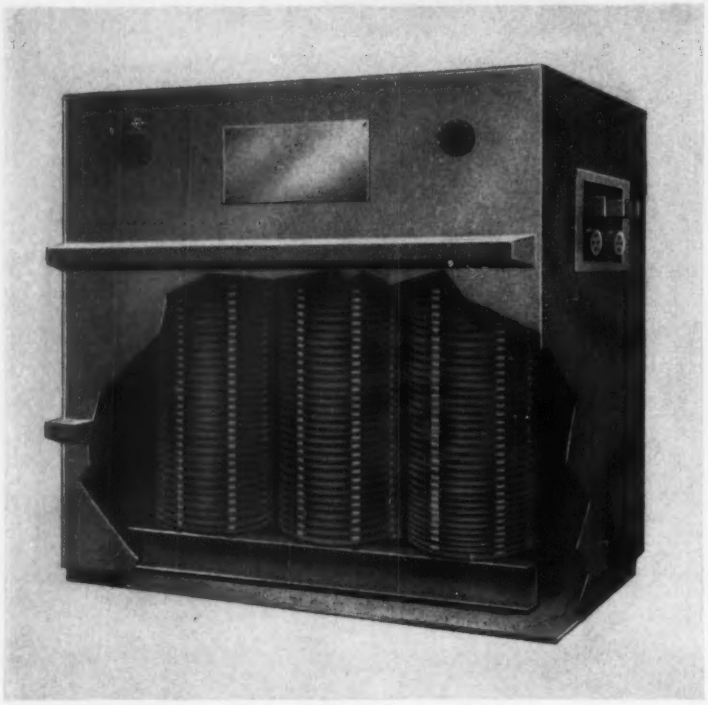
Typical Coppus Blue Ribbon features are: *totally enclosed governor . . . totally enclosed and independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.* You get higher efficiency operation . . . less down time . . . lower maintenance costs.

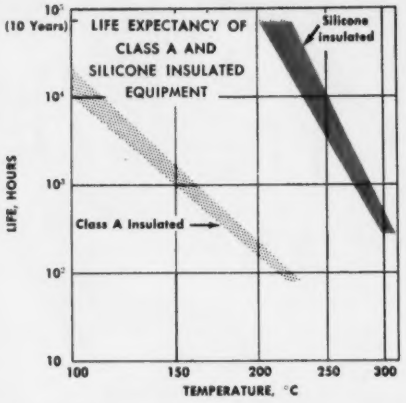
Coppus Turbines are built to customers' specifications, including API and NEMA standards. Send for Catalog 200. Get complete details on Coppus Turbines. Sizes from 1 HP to 250 HP. Write COPPUS ENGINEERING CORPORATION, 169 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

SILICONE NEWS from Dow Corning

The Inside Story on Costs





Look Deeper than the Surface When Specifying Transformers

What a transformer will or won't do . . . its installation and maintenance costs . . . are determined to a large degree by its insulation.

You can assure these four cost-saving factors by specifying a silicone insulation system:

Lowest Cost Installation: Easier to handle and easier to install, they require no costly vaults or barriers . . . can be placed right at load or load center for additional savings on costly low-voltage cable. Silicone insulated dry-types are up to 40% lighter than non-inflammable liquid filled units. Minimum floor loading means least costly supporting structure.

Lower Operating and Maintenance Costs: Virtually maintenance-free, silicone insulated transformers have no liquids to filter or change. Need no space heaters to keep windings dry when de-energized.

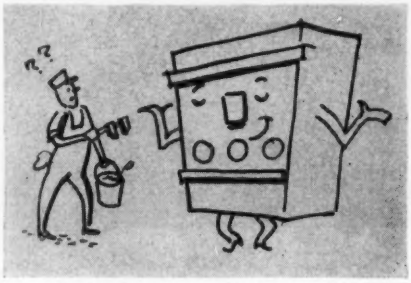
Maximum Safety: Completely dry, they're completely safe! No danger of fire . . . no toxic fumes. Silicone insulated transformers have proved safe under extreme overload and short circuit conditions.

Maximum Reliability: Depending on design, they withstand overloads of 25% to 50% and more above rated capacity. The extra thermal capacity of silicones, demonstrated by the curves in the next column, assures uninterrupted, reliable power.

Today, transformer manufacturers offer two basic designs insulated with Dow Corning Silicones—sealed dry-types and open dry-types.

For power station auxiliaries, you can achieve maximum reliability and minimum maintenance with a silicone-insulated sealed dry-type unit. Requires only a periodic check of pressure gauge and bushings. Or you can save weight by specifying a silicone-insulated open dry-type unit . . . it's ideal for balconies and other minimum floor loading areas.

For underground distribution systems, select a silicone-insulated sealed dry-type network transformer. Fits easily into existing vaults. Undamaged even if flooded, only the bushings, pressure gauge and case need infrequent inspection.



Sealed dry-type transformers require virtually no upkeep.

Send today for full information on silicone-insulated, dry-type transformers and list of manufacturers offering equipment insulated with Dow Corning Silicones. Address Dept. 6921.

SPECIFY Dow Corning Silicones and **SAVE!**

first in silicones

Dow Corning CORPORATION

MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

For more facts circle 238 on Reader Service card, p 121

circle 239 on Reader Service card, p 121 ➤

KEEP OIL WHERE IT BELONGS...

Garlock metal scraper rings prevent leakage, excessive oil consumption

Garlock Style #4400 Scraper Rings allow an exact coating of oil on the shaft . . . return excess to the crankcase. Design benefits are many—*two* scraping edges add greater scraping efficiency, special drain holes relieve pressure buildup, balanced bearing areas prevent "tipping" of the ring.

All rings have a surface finish of less than 10 micro-inches . . . are flat within light band readings . . . come in cast iron, bronze, barium bronze, babbitt, carbon, TEFLON*.

Scraper rings are part of a complete line of Garlock Metal Packings for positive sealing on pumps, engines, and compressors. Designed for the toughest applications, Garlock metal packings are presently handling temperatures as high as +800°F and pressures to 35,000 psi.

Metal packings and scraper rings are more of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. Consult your local Garlock representative for more information, or write

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U. S. and Canada.

**DuPont Trademark for TFE Fluorocarbon Resin*

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Plastics Division: United States Gasket Company

Canadian Division: The Garlock Packing Co. of Canada Ltd.

Six out of eight contracts recently awarded for new power plants specified Curtiss-Wright extruded pressure tubing for steam and reheat lines.

Utility, engineering firm and fabricator select CURMET tubing because its longer length reduces welds —because the metal itself is improved by the exclusive extrusion method. For example, keeping metal under 24,000,000 pounds compression forces flow in both axial and radial directions so that transverse and longitudinal strength are nearly the same.

The foresightedness of public utility management leads to the specification of materials that will stand up under ever-increasing operating temperatures and pressures. And equally as visionary are the engineering firms and fabricators who assist in the design and construction of these power plants for the decades to come.

CURMET tubing, from 8″ to 20″ OD, is available in premium grade carbon steels—chrome-moly, stainless and similar quality alloys.

Write for more complete information on this CURMET process—the superior properties—and the premium quality that it gives to metals.

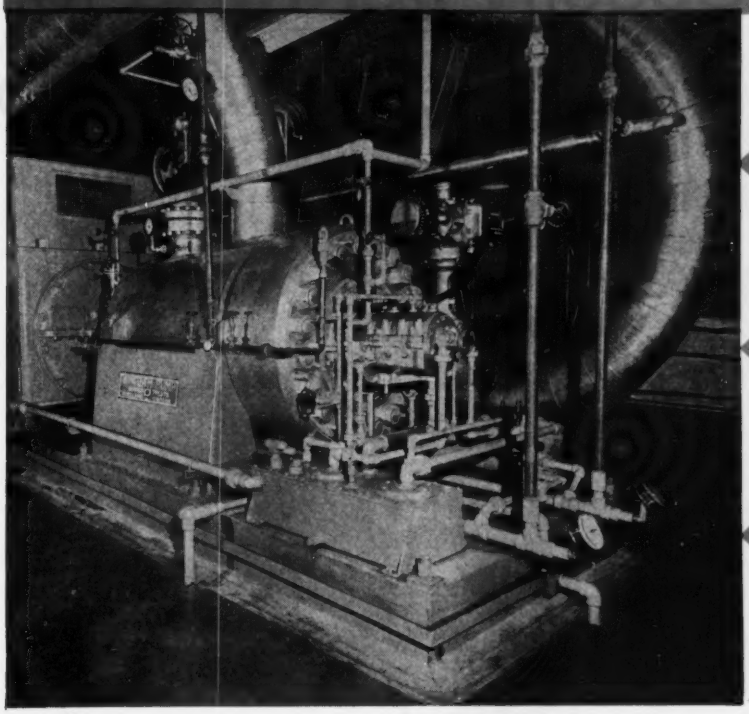
CURTISS-WRIGHT CORPORATION 88 GRIDER STREET **METALS PROCESSING DIVISION** BUFFALO 15, NEW YORK

For more facts circle 241 on Reader Service card, p 121

Bingham

'DOUBLE VOLUTE' BARREL TYPE BOILER FEED PUMPS

THE ULTIMATE IN DEPENDABILITY FOR HIGH PRESSURE SERVICE



BINGHAM BARREL TYPE HIGH PRESSURE BOILER FEED PUMPS

PACIFIC POWER AND LIGHT COMPANY
Glenrock, Wyoming

ENGINEERS AND BUILDERS
Ebasco Services, Inc.

Bingham Barrel Type Boiler Feed Pumps, installed in the Pacific Power & Light Company plant at Glenrock, Wyoming. Each pump is designed to deliver 1875 GPM at 2300 PSI, operating at 3560 RPM.

Bingham "Double Volute" Barrel Type Boiler Feed Pumps are furnished with forged outer barrel for high pressure service. Pumps of this type are available for a wide range of capacities and heads. Your nearest *Bingham* office will be glad to give you full details on request.

BINGHAM BARREL TYPE BOILER FEED PUMPS feature:

- "Double Volute" construction.
- Double suction first stage for low NPSH.
- Balanced axial thrust (no balancing drums needed).
- Kingsbury Thrust Bearings.
- Stuffingboxes are arranged for either packing or mechanical seals.
- Stuffingboxes are subjected to suction pressure only.
- Designed for high operating speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
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For more facts circle 242 on Reader Service card, p 121

Because only Jenkins
gives you this 18 Point Protection
against valve repairs

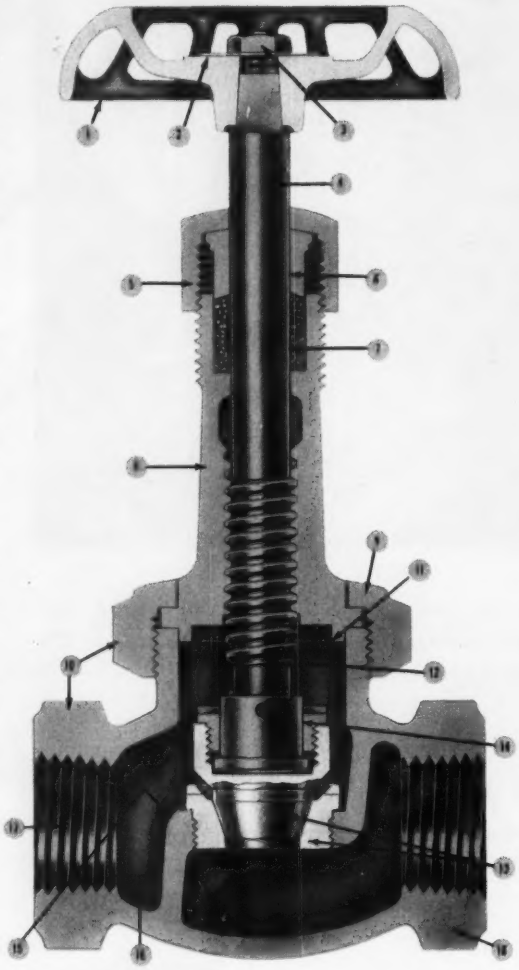
Specify JENKINS for PLUG TYPE Bronze Valves, too

THROTTLED STEAM with its destructive erosive effect on a valve seat . . . hard, seat-cutting substances like rust tubercles, boiler scale, pipe chips. Such valve destroyers have little or no effect on a Jenkins Bronze Plug Type Valve. Jenkins 500 Brinnell Armor Seat defeats them.

There's much more to the durability of these valves than the seat. Jenkins gives you 17 *other* superior features that contribute to long-life and completely satisfying service. All are important to any valve user who wants maximum economy, and only Jenkins gives you all of them. Send for literature which gives full details about them.

Still more protection against valve repairs comes from superiorities which cannot be seen in any picture of a valve: The quality in the castings . . . the precision machining . . . the rigid inspection and testing which every Jenkins Diamond-marked valve undergoes.

You have many sound reasons for specifying Jenkins when the service calls for PLUG TYPE Bronze Valves. And you pay no premium for them. Write us or ask your Jenkins distributor for information folder.



1. PERFECT GRIP HANDWHEEL
2. VALVE INDEX PLATE
3. SECURE WHEEL NUT
4. SPINDLE OF HIGH TENSILE BRONZE
5. LARGE PACKING NUT
6. SELF-ALIGNING PACKING GLAND
7. DEEP STUFFING BOX
8. HEAVY BONNET
9. HUSKY UNION BONNET RING
10. UNIQUE WRENCH LUGS
11. CORRECT ALIGNMENT OF PARTS
12. BACK SEATING PROTECTS THREADS
13. PLUG AND SEAT RING OF CHROMIUM STAINLESS STEEL
14. LOCKNUT
15. FULL DIAPHRAGM-SHELL CLEARANCE
16. LIBERAL DIAPHRAGM WALL CLEARANCE
17. FULL LENGTH PIPE THREADS
18. EXTRA HEAVY BRONZE BODY

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864

Sold Through Leading Distributors Everywhere

JENKINS BROS., 100 Park Avenue, New York 17

Send folder No. 202-A describing Plug Type Bronze Valves

Name & Title.....

Company.....

Address.....

For more facts circle 243 on Reader Service card, p 121

LOUIS N ROWLEY, EDITOR • SEPTEMBER 1959 • ESTABLISHED 1882 **Power**

Do you "type-cast"?

In all probability you do—and so do I. Somehow it seems to simplify things enormously to say "Oh, he's the engineer type." Or the "sales type." Or some other "type."

When we offhandedly classify someone as the "engineer type," we're using a kind of shorthand to wrap up in two words the thought that the man we speak of has the qualities popularly associated with the engineer—the habit of logical thought, an urge to precision, perhaps a degree of introspection and lack of human warmth, etc.

Like shorthand this use of stereotypes can be a timesaver, in conversation, in thinking about people in a general way. But just as two stenographers might interpret the same set of notes differently, so may the "engineer type" in your mind's eye differ from the one in mine.

This is just one weakness of type-casting people—and perhaps one of the least dangerous. The big troubles are apt to come when we apply stereotypes to *individuals*—the individuals we work for, the individuals we work with, the individuals who work for us. Merely laying stress on the word *individual* points the finger at a major reason why type-casting doesn't work in close-range dealings with the people who are vital to us in our role as managers.

Each of us is a bundle of many characteristics, the sum total of which is personality. When we try to fit these assorted traits into a preconceived mold, the odds are against a good match. We have to distort some traits and ignore others to make the actual man conform to our mold. And we wind up by replacing the actual man with a mental image that may not come even close to reality.

Not only does type-casting ignore the evident fact that no two individuals are ever alike—it also overlooks the fact that individuals change. Fortunately, the personality is dynamic—we grow and mature. Consciously or unconsciously, we overcome or minimize some traits, build and strengthen others. Part of being a good manager is learning to work with this dynamic force in the individual personality—perhaps helping to bring about desirable changes, but at the very least recognizing them when they occur.

Type-casting substitutes for the real man an often inaccurate image, and it can conceal from us the growth of the people with whom we work. Perhaps even more important it makes the whole business of working with people abstract and mechanical instead of the real, living, warm and exciting activity it should be. Our job as managers is to accomplish results through people. If we learn to pierce the veil of type-casting and get through to the individuals, we'll do a vastly better managerial job—and we'll find the infinite variety of human personality an endlessly challenging study.

YOUR BEST BUY

General Electric Master Unit Substations are your best "total value" buy—most advanced transformer, switchgear designs . . . completely integrated for modern, economical power distribution.

For a "total value" product appraisal, consider these over-all advantages of factory-built unit substations, then factor in the product superiority of G-E transformer and switchgear components.

With factory-built substations, you benefit from the work of G-E's expert engineering staff which takes over the detail jobs of substation design and frees your engineers for other projects.

Centralizing responsibility with General Electric assures you of a thoroughly integrated, modern product, like the unit substation shown at the right which supplies the entire electrical load for the new United States Gypsum Company plant at Galena Park, Texas. Single billing against one order number means simplified cost control. Coordinated shipment results in quicker, less-costly installation. Factory-built unit substations make possible a building-block approach to low-cost expansion.

Unit substations have been accepted as community "good neighbors" because they are attractive, compact, easy to landscape, and have low noise levels.

After you make the basic determinations of station arrangement, subtransmission and feeder voltages, specify a General Electric Master Unit Substation for the best "total value" buy for your distribution system investment. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

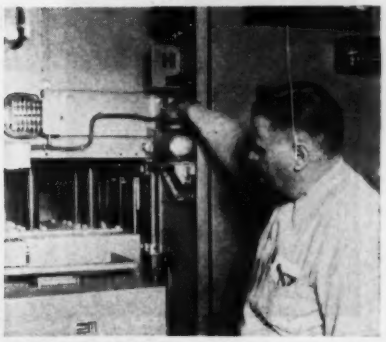
512-32

Progress Is Our Most Important Product

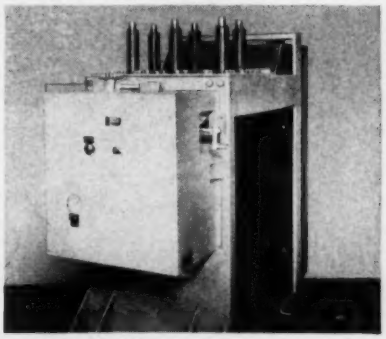
GENERAL ELECTRIC

circle 244 on Reader Service card, p 121

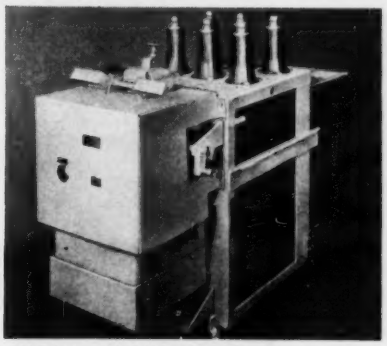
These switchgear features are part of G-E Unit Substation value



VERTICAL-LIFT DESIGN makes inspection, maintenance safer. Operators can actually see when primary disconnects are parted.



FIRST 1000 MVA BREAKER was developed to meet need for increased interrupting capacity. It makes G-E line most complete in industry.



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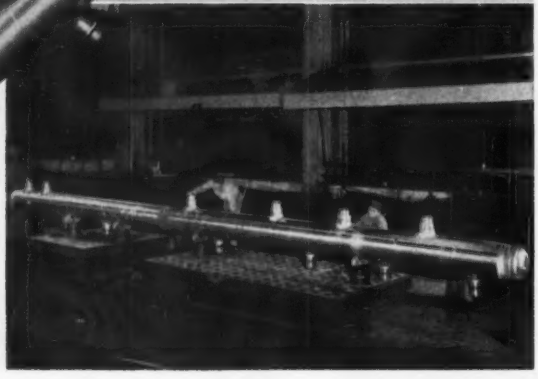

16,500 lb. Stainless Steel Main Steam Header

Stress analysis of a model of power piping is an established procedure at Pittsburgh Piping. It is used to predict accurately the physical reactions of high-temperature, high-pressure piping in service.

The photograph at top left shows a model of main steam piping which is part of a complete system shop fabricated and field erected by Pittsburgh Piping. The enlarged section of the model indicates the relative size and location of the main steam header. This header, shown in the main photo, is fabricated of Stainless Steel Type 316. It weighs 16,500 lbs. and its wall thickness is 3".

Model testing and shop fabrication are two phases of Pittsburgh Piping service which covers every aspect of a piping job—from blueprint through erection. We are specialists—thoroughly experienced in the theoretical and practical aspects, as well as in the code and insurance requirements of high-temperature, high-pressure piping.

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For more facts circle 245 on Reader Service card, p 121

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge

LIGHTNESS of plastic pipe, valves and fittings makes installation an easy job. Worker, above, shoulders 300 ft of pipe made from ABS Polymer. Valves and fittings are 3-in. size, constructed of rigid polyvinyl chloride

Lightweight plastics compete with metal for piping, valve and fitting market

- Experts predict plastic-pipe sales will hit quarter-billion dollar mark by 1975
- Plastic materials readily handle both water and highly corrosive liquids
- Cost is low compared to stainless steels and other corrosion-resistant alloys
- New plastics hold promise of improved pressure and temperature resistance

By R H MARKS, Associate Editor

Explosive growth of the plastic-piping industry is immediately evident when you take a look at the annual sales figures. In 1948 sales amounted to roughly $500,000. But by 1958 they had made a startling increase to $50,000,000. Many experts now feel that annual sales will exceed the quarter-billion-dollar mark by 1975.

Plastics handle a wide range of jobs as an effective alternative to metal pipe, all the way from large overland pipelines to backyard lawn-sprinkler systems. Their ability to carry highly corrosive liquids is proven. Some plastics are better than others at high temperatures; some are best suited for a particular corrosive service. Engineers must know all kinds to use them intelligently.

In general plastic-piping systems have advantages and

disadvantages compared to metal. Advantages include lightness, ease and economy of installation and resistance to rust, corrosion, chemical and electrolytic attacks. Electrical and thermal conductivity are very low. Frictional losses and turbulence are minimized and need for external protection is eliminated. In addition plastics are relatively inexpensive compared to stainless steel and other corrosion-resistant alloys.

Major disadvantages include lack of temperature and pressure resistance. Mechanical strength and dimensional stability needs improvement. High temperature causes loss of strength and stability; long-term service under sustained pressure also lowers working strength. Plastics have low resistance to physical abuse. Finally, all plastics under stress creep to some degree. Since this happens at ambient temperatures it's called "cold flow."

Thermoplastic and thermosetting are the basic classifications

Plastics can be divided into two basic groups. *Thermoplastic* materials can be softened and reshaped by applied heat. *Thermosetting* plastics set or harden into permanent shape with heat of fabrication.

Thermoplastics are usually lower in strength with poorer heat resistance than thermosets. But they are easier to fabricate into finished parts. Thermoplastic piping accounts for about 95% of plastic pipe made leaving about 5% for thermosets. Most thermoplastic pipe is produced by extrusion and can be flexible or rigid depending on the chemicals used. Thermosetting plastics do an excellent job of handling severely corrosive chemicals at pressures and temperatures far above upper limit of thermoplastics. Now let's examine today's array of plastics.

Polyethylene has lowest cost and is most commonly used

Low-density polyethylene accounts for about two-thirds of the overall dollar market for plastic pipe. Commercially available in coils and straight lengths, it's flexible and easily assembled with insert fittings and hose clamps. Chemical resistance is average, but it deteriorates outdoors unless compounded with an ultraviolet-light screener such as carbon black. Polyethylene water lines can actually freeze without rupturing the pipe. Polyethylene is made from either virgin or reprocessed materials but only the virgin grade has the NSF seal of approval for potable water service.

Disadvantages are low allowable working pressures and temperatures. Polyethylene is also soft, easily damaged by cutting, flammable, subject to stress cracking and readily softens and swells in handling hydrocarbons.

Chemical resistance can be improved by irradiation and recent manufacturing changes make it possible to produce denser material with greater strength, rigidity and hardness.

ABS Polymers show improvement in allowable working pressure

Polymers of acrylonitrile, butadiene and styrene (ABS Polymers) are frequently called styrene copolymers, modified polystyrene or simply resin-rubber. Chemical resistance of ABS pipe is very good. Impact strength is excellent even at subzero temperatures. This plastic accounts for about one-sixth of the plastic-pipe market, making it the largest seller next to polyethylene.

Most of the ABS piping installed since its introduction in 1947 is made of Type I resin such as Naugatuck Chemical's Kralastic. Type II, recently introduced, has much better pressure and temperature properties. It now looks as if Type II plastics such as Kralastic HTHT or Cycolac C will practically supplant Type I.

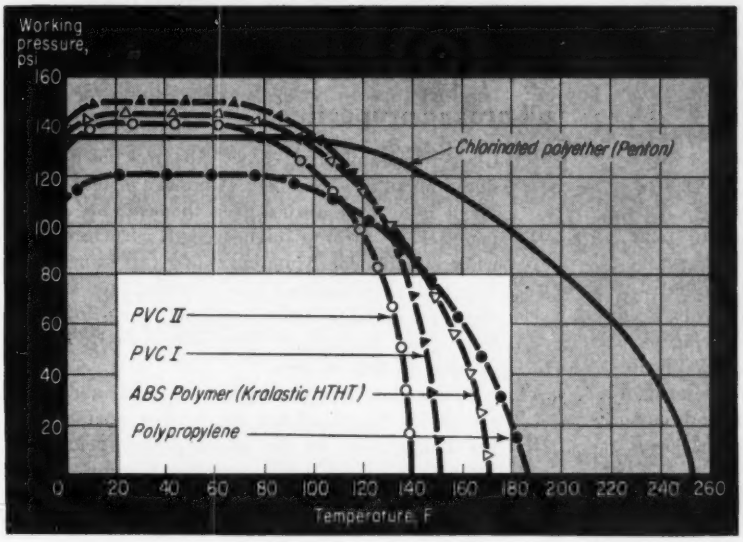
Rigid polyvinyl chloride has excellent chemical resistance

Rigid or unplasticized polyvinyl chloride, introduced in this country about ten years ago, now supplies over 10% of the plastic-pipe market. PVC is high in strength, has excellent chemical resistance, good dimensional stability and does not support combustion. Two grades available are normal-impact PVC (Type I) and high-impact PVC (Type II). Type I is more widely used. Type II has better resistance to mechanical shock, but is more sensitive to temperature. PVC can be molded into flexible pressure tubing by adding the proper plasticizers. It also makes a good inner lining for steel pipe and fittings. Metal backing increases the upper temperature limit to 190 F and the allowable working pressure to 1000 psi. PVC can be chemically bonded to glass-reinforced polyester and epoxy pipe as a special internal lining.

Butyrate finds extensive use in the petroleum industry

Cellulose acetate butyrate or Tenite Butyrate (Tennessee Eastman Co) handles about 2% of the plastic-pipe market. Butyrate comes in

New plastic has greatly improved temperature resistance



Major disadvantage of most thermoplastics is softening and loss of mechanical strength at temperatures quite low compared to metals. Curves, left, show allowable pressures recommended by one manufacturer. Note the marked drop in working pressure over the range of 100 to 150 F. But the new chlorinated polyether (Penton), developed by Hercules Powder, shows promise of handling temperatures up to 250 F. Chemical resistance is almost as good as Kel-F and Teflon. It is readily molded into pipe, valves and fittings and also makes a good lining for pipe. Fabricated cost is less than stainless steel and will probably decrease. Although a practical solvent or plasticizer isn't available as yet, Penton is easily joined with flanged connections or screwed fittings

varying degrees of stiffness from flexible to rigid and can be made transparent or opaque. Mechanical strength is fairly low. Resistance to chemicals, temperature and weathering is only moderate. Butyrate is brittle at low temperatures and supports combustion much like polyethylene and ABS Polymers. But it has given good service in the petroleum industry handling salt water, crude oil and natural gas. There Butyrate's property of resisting paraffin buildup is a valuable asset. Gas-distribution industry also uses it extensively for inserts in new and existing steel lines.

Fluorocarbons earn reputation as "super-plastics"

Fluorocarbons have received much publicity ever since Kel-F and Teflon were developed. Although both materials are fairly weak, they have extraordinary chemical resistance and are thermally stable over an extremely wide temperature range (−200 to + 500 F). But high cost has limited widespread use. One important use is lining steel pipe and fittings. Fluorocarbons are also available in the form of self-supporting laminated pressure pipe, metal-braided and rubber-sheathed pressure hose and ordinary flexible tubing. Both Teflon and Kel-F come in a wide variety of cementable glass-mat reinforced sheets that look promising for large-size pressure piping.

Polyamide resins or Nylon are extruded into pipe and flexible tubing. Nylon is strong, tough and heat resistant, but does a poor job of handling strong acids. Price is too high to compete with other more common plastics.

Acrylic resins such as Lucite and Plexiglas are rarely used for piping, but are valuable when a visual product check is needed.

Saran is now employed mainly as lining for pipe and fittings

Saran or vinylidene chloride was the first important plastic used for piping and dates back about 15 years. It has been largely replaced by other more common thermoplastics. Disadvantages include relatively high weight, tendency to cold flow and brittleness, particularly at low temperatures. But Saran now finds extensive use as an internal lining for steel pipe, valves and fittings. Resulting combination has the excellent corrosion resistance of Saran plus the strength and stability of steel. Its service record is outstanding.

Many newcomers show promise of better strength and stability

Polypropylene is a new plastic that is stronger and more heat resistant than high-density polyethylene with equally good chemical resistance. Chlorinated polyether (Penton) is another new development that shows promise. Excellent heat resistance is combined with dimensional stability and a chemical inert-

ness that approaches that of the fluorocarbons. Curve, p 67, compares its working pressure and temperature with other plastics.

Two new families of thermoplastics that seem to have a good future are the aromatic polycarboate resins (General Electric's Lexan) and the linear acetals (Du Pont's Delrin).

Lexan is strong, tough and chemically resistant. Dimensional stability is good even in hot oil. It has greater heat resistance than any of the thermoplastics with the exception of fluorocarbons.

Delrin has slightly greater strength than Lexan, but resistance to impact and heat is lower. Most outstanding property is retention of its fine mechanical properties during extended periods under stress or during exposure to most corrosive chemicals. Excellent dimensional stability, fatigue life and deformation recovery under a wide range of conditions add up to a desirable combination of properties for industrial piping systems.

All thermosetting plastics have superior heat resistance

Phenolic asbestos pipe has been available for about 20 years under the Haveg trade name. It is nonflammable, has excellent chemical resistance, good dimensional stability and can be used over a wide range of operating temperatures. Disadvantages include the fact that cast-phenolic pipe is weak, fairly brittle and heavy. Cost is high, particularly for the larger sized fittings. Furane asbestos is normally higher in strength and has the additional advantage of resisting alkalies.

Pipe of polyester glass (polyester resins reinforced with glass) is strong, has good chemical resistance (except for alkalies) and isn't subject to cold flow. It can withstand high temperatures for short periods. But prolonged exposure to heat on water service brings an appreciable loss in strength. Under these conditions the pipe will eventually rupture.

Epoxy-glass combination has best all-around properties

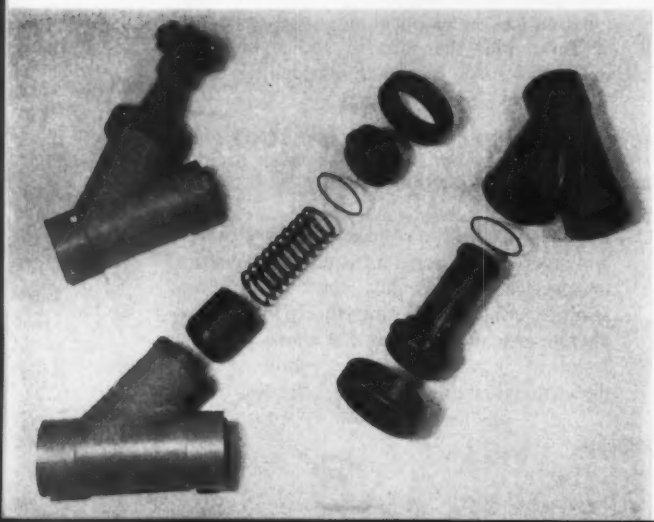
Glass-fiber reinforced epoxy pipe was introduced about five years ago. One way of making it is to tension-wind glass filaments on a mandrel to form a high-strength structure while simultaneously impregnating this structure with thermosetting epoxy resins. Pipe is then heat cured. It's also produced by casting techniques. Strength of the resulting product is equal to that of steel.

Epoxy-glass has the highest strength and, except for fluorocarbons, the highest operating temperature in the plastic-piping field. Strength-to-weight ratio compares favorably with metals. It has high impact strength, outstanding resistance to chemicals and is not subject to cold flow. But long-term exposure to water at high temperatures is not recommended. All these advantages point to a growing number of industrial applications in spite of its presently high price.

Design properties of plastic are quite different from metals

Plastic-piping systems cannot be used everywhere. There are many limitations which must be taken into consideration. For example, long-term service under sustained pressure decreases strength, leading to failure at much lower stress values. In addition most plastics will cold flow. High temperatures further sap strength and stability. Tensile strength, creep

Broader selection of valves and fittings is on horizon



Line of valves and fittings for thermoplastic pipe is fairly complete but those available in thermosetting plastics are still limited. Globe valve, check valve and strainer, left, are 3-in. size constructed of rigid polyvinyl chloride. Check valve in middle and strainer at right are exploded to reveal internals including PVC check-valve spring and PVC strainer. Thermoplastic fittings on the market include all standard elbows, bends, tees, crosses, wyes, couplings, nipples, caps, bushings, plugs, unions, flanges and a variety of metal-to-plastic connectors. Plain socket, flanged and grooved ends are available. Plastic-lined metal fittings can also be used. Plastic valve designs include plug, globe, check, ball, diaphragm, etc. High investment needed for injection molding now restricts availability to smaller sizes. But as plastic-piping systems become more popular, range of valve and fitting sizes will expand to meet this demand

properties, temperature resistance, toughness and thermal expansion are all quite different from piping-system metals.

Piping designers are vitally concerned about stress levels that can be tolerated for prolonged periods without too much deformation or failure. Present practice sets long-term working stresses of thermoplastics at about 20% of the short-term tensile strength obtained from a quick-burst test. Resulting safety factor covers a progressive decrease in strength during continuous service under pressure.

Expansion problems are complicated because of extremely high expansion rates for thermoplastic materials. Coefficients of expansion for plastics are 5 to 20 times greater than for steel and are often hard to predict.

Plastics don't corrode in same sense as metals

Most metal corrosion is electrochemical in nature. It brings about a loss of metal through uniform thinning or localized pitting. Plastic materials are not attacked in this fashion. They corrode by direct chemical reaction or by solvation. In chemical reactions surface of the plastic actually takes part and is slowly destroyed.

Solvation is the more common method of attack. Corrosive fluid penetrates the plastic causing softening and swelling. Plastics usually resist completely or deteriorate rapidly. So it's not practical to use conventional corrosion rates as a measure of resistance. Indicators actually employed are changes in physical properties such as weight or volume increase.

Most attractive feature of plastics is their excellent chemical resistance. Because of this they are less likely to cause any product discoloration or contamination.

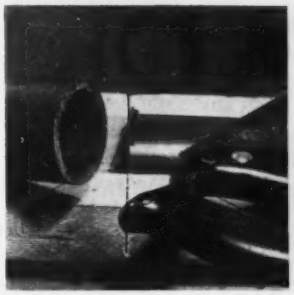
Weathering does shorten plastic life by affecting strength, ductility and impact resistance. Severity of this attack varies with each type of plastic. But all are affected to some degree by the combined effects of sunlight, oxygen and moisture. Opaque additives like carbon black improve sunlight resistance.

Bewildering array of dimensions calls for standards on sizes

Oldest and most widely used method of designating wall thickness is the standard IPS (Iron Pipe Size) schedule system. Recently schedules A and B have joined the standard schedules 40, 80 and 120.

Second system for defining wall thickness is the SWP (Solvent Weld Pipe) system. SWP thicknesses are considerably thinner than

Solvent cement quickly joins PVC pipe and fittings



1 Saw pipe to size with a cross-cut saw. Be sure cut is square

2 Smooth cut end with fine file and remove all of the filings

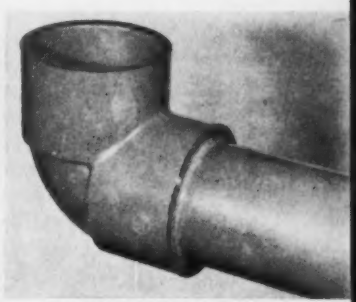
3 Clean connecting surfaces with methyl ethyl ketone

4 Dry-run assembly determines fit and solvent cement needed

5 Liberally brush solvent cement on fitting, then on pipe

6 Take care to put cement on all of pipe covered by fitting

7 Join pipe and fitting. A half-turn twist distributes cement



8 Correctly assembled joint has a small fillet around the pipe

schedule 80 since absence of any threading leaves entire wall thickness for strength.

Most recent method is based on recommended pressure ratings. This system only adds to the confusion and has actually impeded standardization. Wall thicknesses in this system are not a fixed dimension, but vary with the long-term stress of each plastic material. And there certainly isn't any agreement on allowable working stress for most plastics.

One obstacle to rapid growth of the plastic-fittings industry is this lack of standard dimensions to cut down needed inventories.

Ease of joining and supporting plastic pipe is big advantage

Thermoplastic pipe is easy to cut, saw, thread, bend and machine. This means quick, economical assembly, installation and maintenance with very little training needed.

Piping can be joined by a variety of methods. Insert fittings with hose clamps are popular for polyethylene pipe. Screwed joints are the oldest and most conventional way. But use is limited to rigid heavier-wall schedule pipe mainly because of impaired strength at the threaded ends of thermoplastics.

Objection to screwed joints doesn't apply to thermosetting plastics. Polyester and epoxy pipe are regularly furnished with threaded ends molded integrally on the pipe. But standard thread-cutting techniques can't be used since this would cut into the glass cage.

Solvent welding of polyvinyl chloride, ABS and butyrate is very popular. It is the preferred method for joining thermoplastic pipe. Joint is stronger and surer than a threaded one and is completed much faster. It also permits thinner piping for an equivalent pressure rating. Step by step procedure for solvent cementing is given on p 69.

Grooved joints can also be used and have the advantage of rapid and easy uncoupling. Ability to take up minor amounts of expansion and contraction is also valuable. This often eliminates need for costly expansion joints.

Flanging is one of the time-proved methods of joining plastic piping. These connections are tight, strong and easy to assemble and take apart. Flanges are attached to the pipe by screwing, welding or cementing.

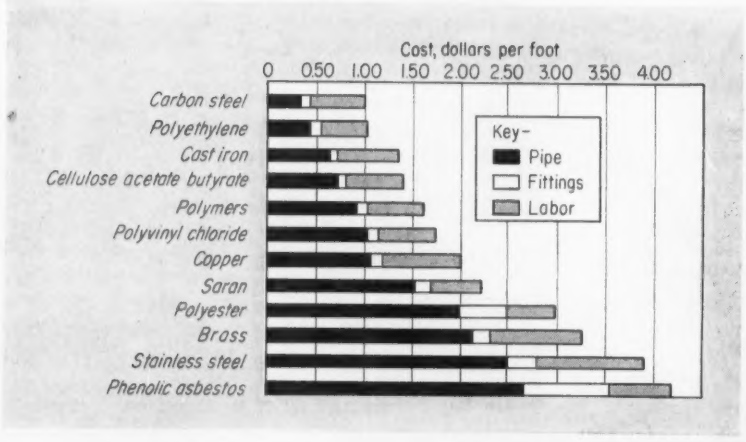
Cemented joints are an effective alternate to screwed or flanged connections for glass-reinforced polyester or epoxy piping.

Thermoplastic pipe should be supported at intervals about one-quarter to one-half those needed for steel pipe. Use standard supports; be sure bearing surface is broad and smooth.

Industrial use of plastic pipe will show spectacular growth

Plastic-piping systems are already selectively competitive with metals. Chart, below, shows that economics favor the use of plastics for corrosive service. Corrosion-resistant alloys are ten to twenty times more expensive than carbon steel. Improved temperature resistance of new plastics means they can soon tackle tough problems like condensate-return-line corrosion. Why feed chemicals and use an elaborate water-treating system if a plastic-piping system solves the problem? As these and other new jobs are tackled plastics will compete more successfully with metals for a greater share of the overall piping market.

Cost is important factor in choosing materials



Cost is an important factor in plastic technology because of the large number of competing materials. For practically every use there are several materials suitable from the standpoint of physical and chemical properties. Selection then boils down to a matter of economics. Chart, left, compares costs using carbon steel as a base. Cost of most plastics will tend to decrease with new production techniques and increased use. In addition to advantages of low shipping and handling costs there are savings in insulation and external corrosion protection. But to reap all these economies engineers must become more adept at using plastic piping materials

Are you an optimist or pessimist when . . .

Selecting pressure rating for closed feedwater heaters?

By I J KARASSIK*
Worthington Corporation

Survey of utilities and consulting engineers on this topic reveals differences of opinion among power-plant designers

Part I of this article in July POWER, pp 60-61, covered the two extreme approaches in selecting pressure rating of closed heaters in the boiler-feed pump discharge. For easy reference we have dubbed these the *optimistic* and *pessimistic* approach. There are, of course, a great many other possible design philosophies falling between these two extremes. Before considering them, let's briefly review our understanding of the extremes.

First, take the case of the constant-speed pump. Discharge pressure at full load corresponds to turbine-design throttle pressure plus all accumulated pressure drops at full-load flow. These include losses in steam piping, superheater, economizer, heaters, piping, valves and fittings and feedwater regulator, plus the static head. As load is reduced the feedwater regulator throttles excess pump pressure. Unless regulator is located ahead of the heaters, these units receive full pump discharge pressure at minimum flow used for bypass protection.

Pessimistic approach says that maximum discharge pressure at minimum flow must be calculated on basis of cold-water specific gravity. This pressure is used to select heater pressure rating no matter where the feedwater regulator is located.

Optimistic approach assumes that the pump is hardly expected to handle cold water very frequently. An optimist attempts to place feedwater regulator right after the pumps and depends on its satisfactory operation and the additional protection of various relief valves.

Pessimist remains a pessimist even when boiler-feed pumps operate at variable speed. He still chooses shutoff pressure at full speed to rate his heaters. An optimist places his faith in satisfactory operation of the variable-speed control. Heater can then be designed for full-load discharge pressure since this is the highest pressure level normally encountered.

Difference between an optimistic and a pessimistic approach can have a significant effect on heater cost. Table, below, compares heater cost at various pressure levels. Heater rated at 1500 psig is used for the base price. All higher-rated heaters are priced as a percentage of this base. Figures are only approximate since heater price also varies with size, type of construction, materials, maximum operating temperatures, etc, but chart is valuable as a guide when choosing between two extremes of optimism and pessimism.

Now let's apply this chart to the example cited in Part I. Optimistic approach puts heater pressure in the 2750-psig class with a price factor of 138. But designing for maximum possible discharge pressure in an open cycle calls for a 3500-psig class heater with a price factor of 174. If a closed cycle is used a 3750-psig heater is needed with a price factor of 188. So pessimism results in an appreciable cost increase of 26% for open-cycle, 36% for closed-cycle system.

Survey results. To disclose degree of optimism prevailing among today's designers of high-pressure power plants 16 different companies were surveyed. Seven of these are utilities and nine are consulting engineers engaged in power-plant design. They were asked these three questions:

(1) Assuming that the boiler-feed pumps operate at constant speed, what margin would you add to estimated pressure at shutoff in specifying the pressure rating of closed heaters in the boiler-feed pump discharge line? Would you consider cold-water discharge pressure or normal low-load temperature?

(2) If variable-speed drive is used by means of either hydraulic couplings or steam turbines, is your heater pressure rating based on maximum discharge pressure expected of the pump?—this, of course, is discharge pressure at design capacity, since reduced loads require reduced discharge pressures to conform to required system-head curve. Or do you take a pessimistic approach and set pressure rating of heater by discharge pressure that pump can develop at shutoff when operating at full speed?

(3) In the event that pumps oper-

Closed-heater price level depends on pressure rating

Heater class	Pressure rating, psig	Price factor, %
1	1500	100
2	2000	110
3	2250	119
4	2500	128
5	2750	138
6	3000	150
7	3250	162
8	3500	174
9	3750	188
10	4000	202

*Mr. Karassik is Consulting Engineer and Manager of Planning, Harrison Division

ate at constant speed, have you considered locating feedwater regulator on the upstream side of the heaters, that is, between boiler-feed pump discharge and heaters themselves, so as to reduce pressure on heaters? This, in effect, permits you to design heaters for only discharge pressure occurring at design capacity. If not, what objections do you have to such an arrangement?

Answers received are tabulated, right. In some cases the replies are condensed because a number of designers included various other comments germane to the issue. These were extremely helpful in focusing attention on some allied problems.

Examination of survey results certainly doesn't reveal any unanimity of opinion. Score stands just slightly in favor of the optimist. In the case of constant-speed pumps, there are five optimistic approaches and seven pessimistic ones. One answer is inconclusive and four designers do not use constant speed.

When variable-speed pumps are used, again leaving out inconclusive answers, we find there are nine optimists and four pessimists.

Location of the feedwater regulator finds six optimistic designers and three who take the pessimistic point of view. Remainder either do not use feedwater regulators, gave no answer or gave an answer that's difficult to put completely in one camp or the other.

Interpretation given by designer to either the ASME Code or local state codes for unfired pressure vessels is a factor that probably influences these decisions very significantly. It is quite apparent from some of the survey answers that this interpretation is frequently considered a difficult one. There is also a great deal of difference between the requirements of various states. This situation seems to indicate a need for greater standardization of codes and their interpretation. But this matter is one that falls into the province of the utilities themselves and can best be considered by one of their appropriate bodies such as the Prime Movers Sub-Committee.

As mentioned earlier, some comments threw considerable light on the intricacies of deciding on heater pressure rating. For example, the question of relief valves arouses a great deal of controversy. A number of designers state that channel relief valves are capable of relieving sufficient feedwater to protect the heaters from full pump shutoff discharge pressure. Others do not consider relief valves practical for full heater protection. Several designers pointed out that if lower heater design pressures are used, appreciably larger and more expensive channel relief valves are needed.

Parallel problems that may be introduced by various valves and fittings are pointed out in one comment:

"There is one other item of interest at the present time in connection with shell and tube feedwater heaters which is not covered by the questions. This concerns the specification and fabrication of heaters to give the same reliability as the balance of the feedwater system and thus make possible elimination of expensive isolation and bypass valves at the heater channel. Not only are valves subject to leakage at the seats after a few openings and closings, but there is always danger of gasket leaks when flanged valves are used.

In a 66-mw 1800-psi plant now under design, it has been decided to eliminate all isolation and bypass valves on both high- and low-pressure heaters. Condensate and feed lines will be welded directly to channel nozzles. In this case capital saving is in the order of $20,000 to $25,000. Seal-welded channel covers and tubes welded to the tube sheet give a degree of reliability which in the opinion of many designers warrants elimination of these valves. There is always the possibility of a split tube causing a plant shutdown, but it is seldom practical anyway to replace the tube in modern U-tube bundle designs. So possibility of a short shutdown for plugging ends of a ruptured tube is a chance well worth taking. In my own experience, several plants have had considerably more maintenance with isolation and bypass valves than with the tube-side components of the heater."

Conclusions. This survey was not undertaken to make specific recommendations on the right method of selecting pressure rating for closed feedwater heaters. Actually, there is no right or wrong method. Instead there are various concepts which may yield different answers under different circumstances. What's right in one case may be entirely wrong in another. This study was conceived to reveal the thinking of a number of designers on the subject. A more complete survey is probably advisable and can be handled most readily by the utilities as a body. In summary our survey shows that:

(1) Opinions are reasonably split between optimists and pessimists on the justification for holding heater rating pressures down. But we must note that those who do take the optimistic view report no maintenance problems. This might suggest to the pessimist that an experimental departure from his position may be worth considering for at least one installation.

(2) It is much more important to take a second look at both viewpoints in the case of closed feedwater cycles. Here a pessimistic approach is more expensive than in an open cycle.

(3) A simplified code interpretation would be extremely helpful when choosing rating pressures.

(4) A significant source of capital savings is available if both isolation and bypass valves are eliminated. Whether this is justifiable depends upon experience of a given utility with these valves and the frequency of heater tube failures.

(5) As operating pressures continue to increase and as variable-speed operation of boiler-feed pumps gains in favor, more power-plant designers will face the choice between optimism and pessimism. Unless we see a sudden growth of unscheduled outages directly traceable to over-optimism, I venture to predict that the ranks of optimists will increase in the years ahead.

Poll of power engineers reveals differences of opinion →

Survey score stands just slightly in favor of the optimist approach

Classification	(1) Pressure rating of heaters for constant-speed boiler-feed pumps	(2) Pressure rating of heaters for variable-speed boiler-feed pumps	(3) Comments on location of feedwater regulator
(A) Consulting engineer	No margin over shutoff pressure	Pessimistic approach: Design for full pump discharge pressure at shutoff	Locate feedwater regulator ahead of heaters. Relief valve gives protection
(B) Consulting engineer	See comments on location of feedwater regulator in column (3)	Employ about 100-psi margin over maximum expected discharge pressure at pump design capacity	Have located feedwater regulator ahead of heaters. Believe this is dictated by sound economics
(C) Consulting engineer	Margin of 5% over shutoff pressure	Pessimistic approach: Design as if pumps operate at constant speed	Locate feedwater regulator either ahead of or after heater. Safety valves are used. We find little cost advantage at either location
(D) Utility	Margin of 50 psi over estimated shutoff pressure with cold water	Use margin of 250 psi over maximum expected discharge pressure at pump design capacity	Have located feedwater regulator ahead of heaters. Relief valve protection is provided
(E) Consulting engineer	Margin of 10% over estimated discharge pressure at shutoff on cold water. If resulting extra cost is excessive this margin is reduced to 10% at normal operating temperature	Pessimistic approach: Design as if pumps operate at constant speed	Do not locate feedwater regulator ahead of heaters since other valves in system can still cause high heater pressure
(F) Consulting engineer	No margin over shutoff pressure	Optimistic approach: Design for pump discharge pressure at rated capacity	Locate feedwater regulator ahead of heaters and design as if pumps operate at variable speed
(G) Consulting engineer	Generally use closed cycle. Employ shutoff head of condensate pumps plus that of boiler-feed pumps	Optimistic approach: Design for shutoff of condensate pumps plus design discharge pressure of boiler-feed pumps plus a few feet for pressure drop	No answer
(H) Utility	Do not use constant speed, but would design for shutoff if they did	Design for rated total head at pump rated capacity. Since this exceeds the system head curve somewhat, a margin is available	Do not use feedwater regulator. Do not use constant-speed pumps
(I) Utility	Employ from 90 to 95% of pump dead-end pressure. Test pressure is from 135 to 150% of dead-end pressure	No variable-speed pumps are used	Not decided at this moment
(J) Utility	Margin of 150 psi over shutoff pressure on cold water. Some consideration given to effect of heaters on cost	Employ margin of 150 psi over maximum pressure at maximum flow provided this falls within ASME and state codes for unfired pressure vessels	We have been locating feedwater regulator ahead of heaters in many stations since 1947
(K) Utility	Use highest pressure all heaters can be subjected to under all contingencies	No variable-speed pumps are used	Locate feedwater regulator downstream of heaters
(L) Consulting engineer	If feedwater regulator is upstream of heaters, employ maximum load pressure plus any margin required by local authorities. If feedwater regulator is downstream of heaters, use cold-water shutoff pressure	Without any feedwater regulator use pressure at maximum load for either motor or hydraulic coupling drive. For turbine drive either take data from column (1) or 2/3 of system head curve on cold water at overspeed trip point. Use whichever is greater	Locate feedwater regulator upstream of heaters
(M) Consulting engineer	Margin of 5% over cold-water shutoff pressure	Employ 5% margin over pump discharge pressure at design capacity	Always locate feedwater regulator upstream of high-pressure heaters whenever physical arrangement permits
(N) Utility	Do not use constant-speed pumps	Design for full-load discharge pressure plus a small safety factor. Our big concern is not heater design pressure but design pressure of piping	No objection to locating feedwater regulator between pumps and heaters. It is used only for startup and is normally locked in full-open position
(O) Utility	Do not use constant-speed pumps	Design pressure for heater tubes on boiler-feed pump discharge side is determined by accumulated pressure of top safety valve on boiler	No answer
(P) Consulting engineer	Employ 5% operating margin over constant-speed boiler-feed pump shutoff pressure handling cold water	Pessimistic approach: Assume feedwater regulator will fail and pump may deliver shutoff pressure at full speed	Pessimistic approach: Design as in column (1) or (2) regardless of feedwater-regulator location

Where two large induction motors must be started with reduced inrush current yet you want to save space and keep down initial costs, start them one at a time and you can . . .

Start two motors with one reactor

By C P CROCO and R N HIXSON, Westinghouse Electric Corporation

A single-reactor sequential starting scheme can be used with two induction motors and save space and dollars. However, you will need extra interlocking and protective features to safeguard against possible abnormal operation. Scheme used successfully with two 2000-hp, 2300-volt, 3-phase, 60-cycle, 591-rpm induction motors is shown in accompanying diagrams. Motor circuit is shown by 1-line diagrams; much simplified control-circuit schematics are included.

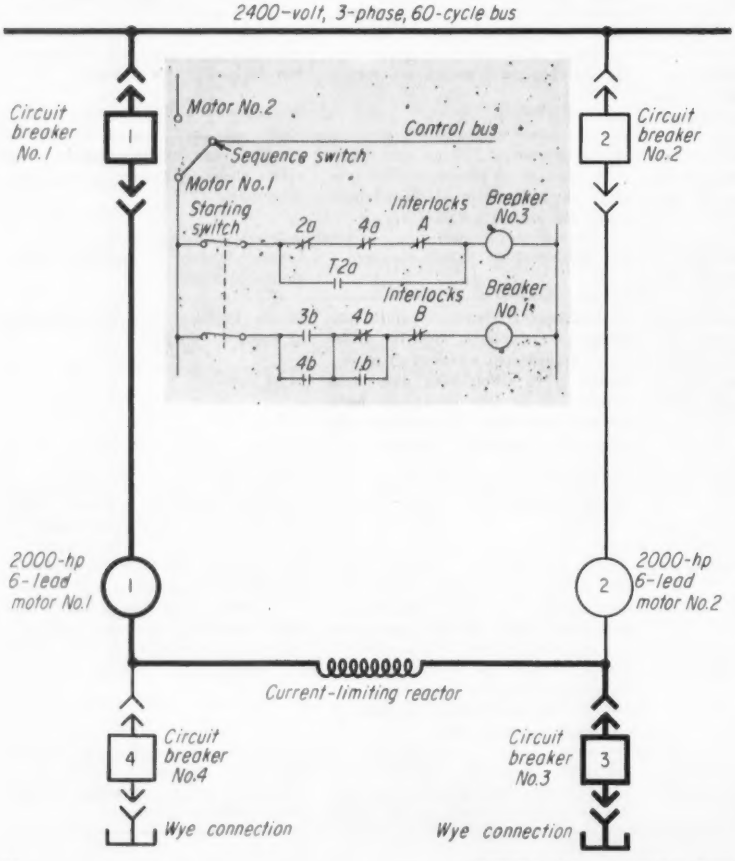
Unique relaying scheme is used so that either motor can be started first and interlocked to insure proper sequencing. If the operator wants to inch only one motor, he selects it to be started first and then stops it without starting the second motor. Motors are wound so that both ends of each phase are brought out and the wye connection is made automatically through circuit breakers.

First stage is initiated when operator selects which motor is to be started first. This he does by sequence switch in sketch, but more complicated circuits may be used in practice. With No. 1 motor starting first, operator closes No. 1 motor switch, shown as starting switch in sketch. This completes circuit through normally closed interlocks on breakers No. 2 and 4 and through a series of interlocks and switches here represented as interlocks *A*. What these interlocks actually are will depend on the characteristics of the particular drive, the process and the safety features desired. Breaker No. 3 is thus closed completing the wye connection of motor No. 1 through the reactor.

Next, main starting circuit breaker No. 1 closes. It's energized through interlocks on breakers No. 3 and 4 and interlocks *B*. This applies power to the No. 1 motor with the reactor in series.

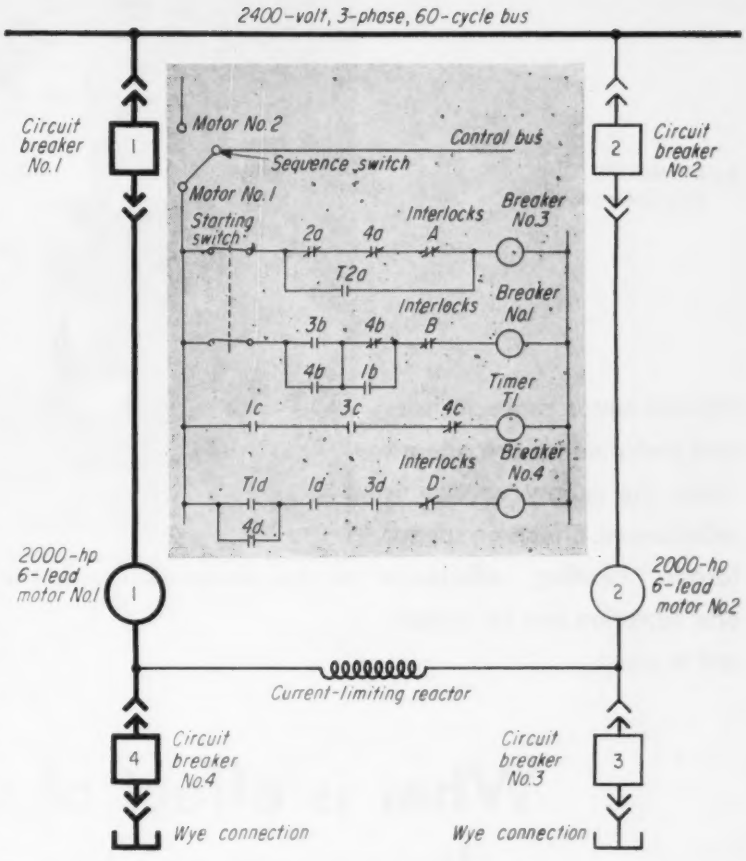
Second stage is full-voltage operation of motor No. 1. Timer relay *T1* is energized when breakers No. 1 and 3 are closed and breaker No. 4 is still open. After a time delay, circuit breaker No. 4 is closed through interlocks on breakers No. 1 and 3 and interlocks *D*. When No. 4 breaker closes, it trips breaker No. 3, opening the connection through the reactor. Timer relay *T1* is also de-energized as contacts *3a* open.

Third stage is starting up the second motor. This is accomplished without changing the sequence selector switch from its original No. 1 motor position. Wye connection for motor No. 1, closed through circuit breaker No. 4, serves at the same time



FIRST STAGE of starting can be seen in this simplified power and control schematic

SECOND STAGE has first motor running on line when breaker No. 4 shunts reactor



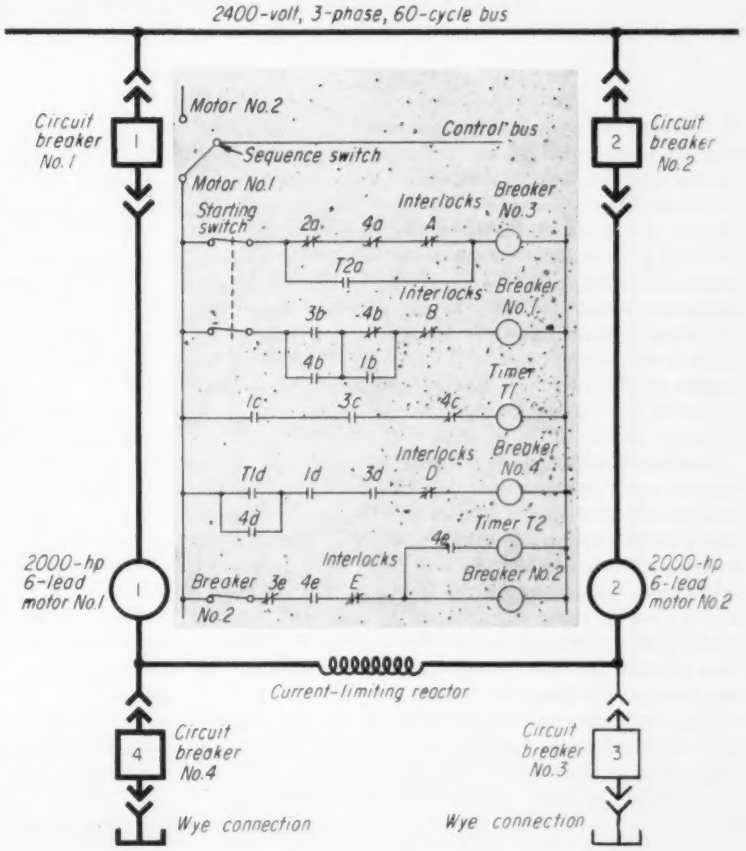
as wye connection for motor No. 2 through the reactor. When operator closes the control switch for main circuit breaker No. 2 the circuit is completed through interlocks on breakers No. 3 and 4 and through interlocks *E*. When circuit breaker No. 2 closes, motor No. 2 is energized through the reactor. At the same time timer relay *T2* is energized through a normally open interlock on circuit breaker No. 4.

After a predetermined time, timer relay *T2* closes its contacts in series with several interlocks and switches, but in effect bypassing the relays and interlocks which operated to close breaker No. 3 in the first stage of operation. This closes breaker No. 3 and shorts out the starting reactor. Both motors are now connected across the line. Reactor remains connected between the two wye connections which are at equal neutral potential, and is therefore shorted out.

Scheme described is for a process in which both motors must be running in order to begin operation. So No. 2 motor may be used as a preference starting unit, and by throwing the sequence selector switch to the No. 2 motor position operator initiates the functional operation. This is to close the reactor-shorting circuit breaker No. 4 to form the wye connection on the reactor, and then to proceed to close starting breaker No. 2, applying reduced voltage to induction motor. Then he closes a transition timer relay to close the reactor-shorting breaker No. 3.

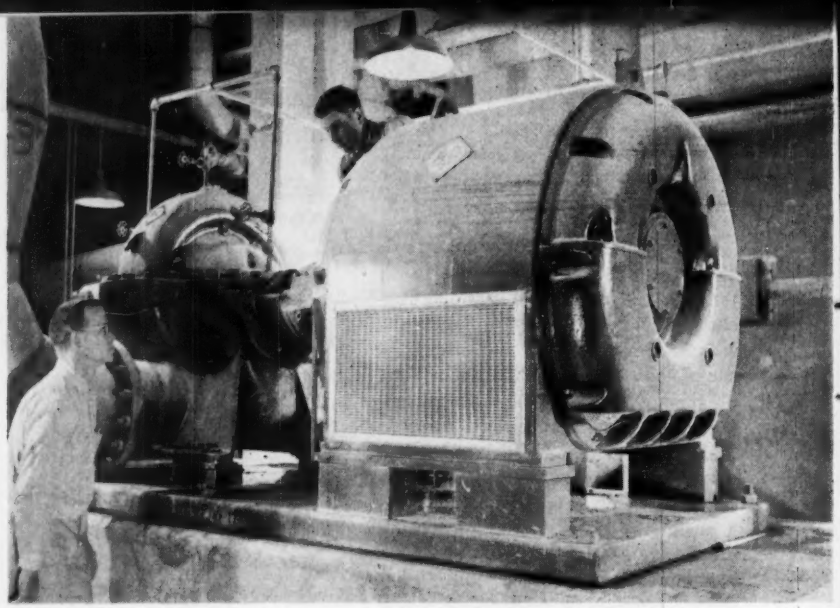
Starting of No. 1 motor is then followed through the same sequence as previously described for the No. 2 motor when No. 1 motor was used as the preference unit.

A starting scheme essentially as described has been used by a leading tube manufacturer on one of the tube-piercing cone drives. It has performed successfully for the two years it has been operating in the plant.



THIRD STAGE starts second motor through reactor. Later breaker No. 3 shunts reactor

By R C MOORE
Allis-Chalmers Mfg Co



EFFECTS of unbalanced 3-phase supply voltage assume importance on larger machines like this 600-hp induction motor driving a fan pump for paper stock in large paper mill

Normal motor characteristics and performance are altered when the supply voltage is unbalanced. Effects on speed, torque, heating, efficiency and vibration can be important to you

What is effect of unbalanced voltage on motor performance?

A balanced voltage supply is presumed for normal motor characteristics found in association standards and commercial publications. Unbalanced-voltage operation of polyphase induction motors can produce these adverse effects: (1) speed drops slightly for a given load near full load (2) efficiency decreases due to additional motor losses (3) heating is increased by additional losses; losses are greater for motors having skin-effect rotor bars (4) winding heats unequally because of unequal copper losses in the several phases (5) line-current unbalance increases much faster than voltage unbalance (6) normal protective devices may be ineffective (7) noise and vibration may develop or increase.

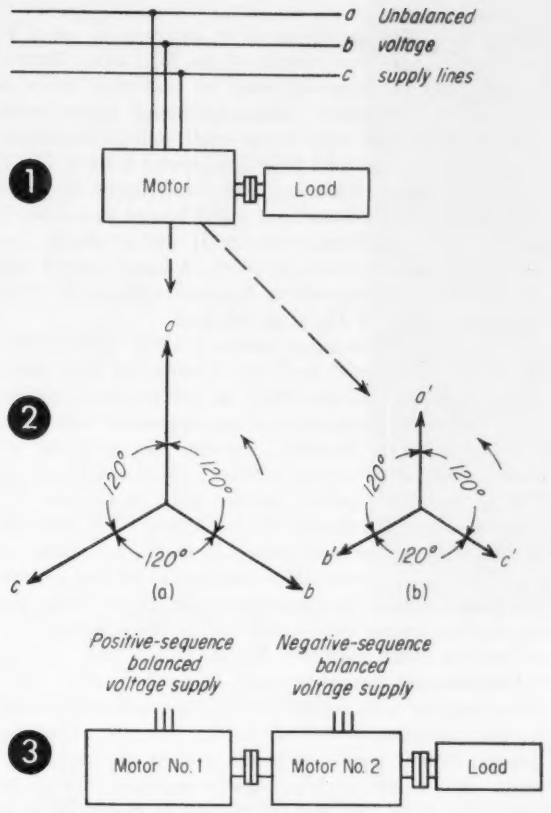
Balanced-voltage power supply causes a 3-phase induction motor to rotate in a direction determined by the rotation of the magnetic field in the air gap. Field rotation depends on sequence of currents (in the symmetrically wound stator) which is the same as sequence of voltages of the power system. If coil groups of phases *a* and *b* of the stator are adjacent to each other so that winding currents reach a maximum value in phase *b* after phase *a*, the air-gap magnetic field and the rotor rotate from *a* to *b* phase-coil groups.

Motor may now be disconnected from the power supply and full speed maintained by some external means. Reapplication of power, but with any two power leads reversed, reverses rotation of the air-gap magnetic field and induces double line frequency (nearly 120 cycles for a 60-cycle power supply) in the rotor. Motor torque developed is now a braking torque. If the external means of maintaining speed is removed, braking torque brings motor to a stop and causes it to run up to full speed in the opposite direction. Torque, power factor, efficiency, load current, etc are the same for either the straight- or reversed-lead power-line connection at full speed.

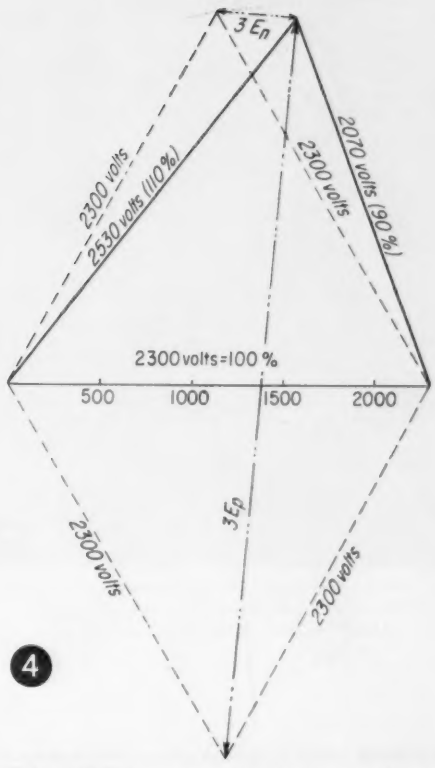
Unbalanced-voltage supply, when no neutral wire is involved, may be resolved into two sets of balanced-voltage vector systems by the method of symmetrical components. Balanced set of vectors labelled *positive-sequence voltage system* in Fig. 2 (a) has the same effect on a motor as a normal connection while the negative-sequence voltage system, Fig. 2 (b), produces the effect of interchanging two lines to the motor.

Motor may be considered a 2-motor scheme, Fig. 3, for analysis. Each "motor" has same horsepower and design as the actual motor. Calculations made for torque, etc of the 2-motor system, with each motor operating on its own balanced voltage supply, correctly predict performance of actual motor connected to unbalanced supply. Advantage of the 2-motor scheme is that familiar balanced-voltage 3-phase calculations can be used, simplifying the problem.

Voltage values of the two sequence systems depend on



TWO-MOTOR CONCEPT helps explain how unbalanced voltage can be resolved into balanced sets of voltages when neutral isn't involved



GRAPHICAL METHOD constructed in the manner above may be used to obtain sequence systems from actual unbalanced voltage

the degree of voltage unbalance of the supply. The greater the voltage unbalance in Fig. 1, the greater the negative-sequence voltage to motor No. 2 of Fig. 3. When the line voltages of Fig. 1 are balanced, motor No. 2 has no negative-sequence voltage and motor No. 1 operates at 100% or rated nameplate value and performs identically to motor of Fig. 1. Or when one line of the supply of Fig. 1 is opened so that the motor operates single phase, its greatest voltage unbalance, then the voltages of each sequence system of Fig. 3 are equal.

Using the 2-motor concept, characteristics may be calculated from a standard equivalent circuit. As the positive-sequence voltage system is balanced, balanced-voltage performance calculations may be used. And when motor No. 2 is supplied negative-sequence voltage only, motor's performance may be calculated from its equivalent circuit using standard methods. Data obtained from the two motors are combined to explain operation of actual motor.

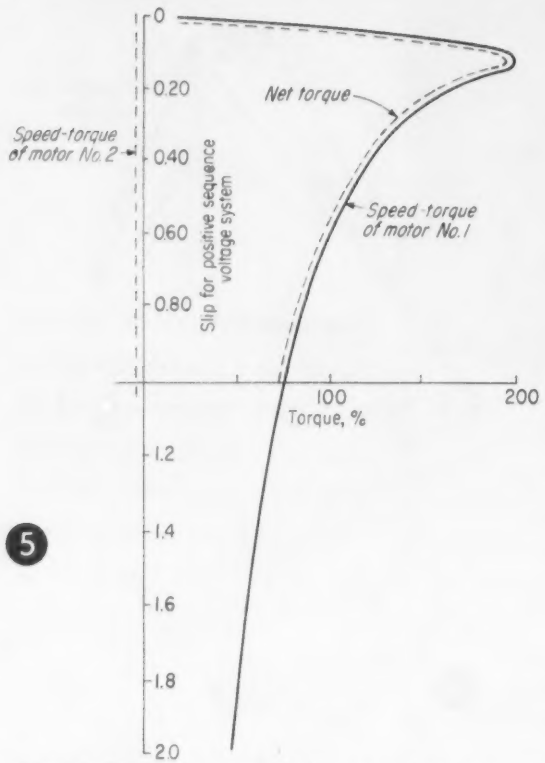
Positive- and negative-sequence systems of balanced voltages can be determined from the actual unbalanced voltage system by various methods, some of which require a fair amount of mathematical facility. However, a simple graphical method may be used.

Graphical method is shown in Fig. 4 where line-to-line supply voltages are assumed to be 110% and 90% of rated motor-nameplate voltage. These percentages for a 2300-v motor correspond to 2530, 2300 and 2070 volts respectively. Vector diagram for the unbalanced voltage supply is drawn to a suitable scale and equilateral triangles are drawn as shown in dashed lines above and below base of the unbalanced-voltage triangle.

From geometry of the vector triangles it can be shown that the straight-line distance (shown chain-dotted) between apex of the unbalanced-voltage triangle and apex of the upper equilateral triangle is equal to three times the terminal-to-neutral negative-sequence voltage. Negative-sequence voltage in Fig. 4 is found to be 153 volts, terminal-to-neutral, equivalent to 11.5% terminal volts.

Similarly, the straight-line distance between the apex of the unbalanced-voltage triangle and the apex of the lower triangle is equal to three times the terminal-to-neutral positive-sequence voltage. Latter is found to be 1323 volts, equivalent to 99.6% of nameplate volts. *Unbalance factor* is the ratio of negative- to positive-sequence voltage, or 11.65% for Fig. 4.

Torque and speed are affected slightly by voltage unbalance. Motor torque may be assumed to vary as the square of the applied voltage. Motor No. 1 therefore develops a torque which is $(0.996)^2$ or 99.2% of rated value. Direction of rotation of the two motors is determined by motor No. 1, supplied by the positive-sequence voltage. Negative-sequence voltage applied to



5

SPEED-TORQUE curves for 2-motor scheme show braking torque of negative-sequence motor and net torque developed by actual motor

motor No. 2 produces a field in the air gap which rotates backwards with respect to rotor, which is turned forward by the greater torque of motor No. 1. This field induces nearly twice supply-frequency currents in rotor of motor No. 2 when near rated load, and develops a braking torque which subtracts from torque of motor No. 1. The braking torque is considerably less than the forward torque, largely because the negative-sequence voltage is much smaller.

Difference torque (dashed line in Fig. 5) of the two motors each operating on its own balanced-voltage system of opposite phase sequence is equal to torque developed by actual single motor. For an idea of the amount of braking torque of motor No. 2 analyze its torque performance. As an example, assume an induction motor to have 650% locked-rotor current, 75% locked-rotor torque at full voltage. It is type of motor whose impedance, and therefore line current, doesn't change appreciably from locked conditions to full reverse speed of braking conditions described. At full reverse speed motor torque is 50% of full load, Fig. 5. Since torque varies as square of voltage, the braking torque for 11.5% negative-sequence voltage is about $(11.5/100)^2$ x 50% or 0.66% of rated torque. For an induction motor using eddy current or skin-effect rotor braking torque may be 3 to 4% of rated torque.

Operating near full load on an unbalanced voltage, therefore, a motor suffers a slight reduction in torque ability and consequently a slight decrease in speed to meet the torque requirements of the load being driven.

Efficiency is decreased when an induction motor is operated on unbalanced voltage. Additional copper losses may be substantial even for a small voltage unbalance. Losses may be calculated from the 2-motor drive of Fig. 3 by simply adding the stator and rotor copper losses of each motor. Load current and stator loss of motor No. 1 at 99.6% (as previously calculated) and at slightly increased slip may be taken as 100%. A stator current and loss of 100% corresponds to balanced voltage of 100% applied to motor of Fig. 1 at full load.

If voltage of the negative system is 100% (2300 volts) the motor current may be 5 to 6.5 times full load, latter figure applying to skin-effect or eddy-current rotors. Since the negative-sequence voltage applied to motor No. 2 is 11.5% (in the example), current, varying as the applied voltage, is 6.5 x 11.5/100 or 75% of rated current. Due to negative-sequence current only, stator loss for motor No. 2 is therefore $(0.75)^2$ x 100 or 57%. Sum of the stator losses for both motors is 157%, and motor of Fig. 1 has 57% greater stator loss than if the line voltage had been balanced at nameplate value. Rotor losses are also higher during unbalanced-voltage operation because of braking effect of motor No. 2.

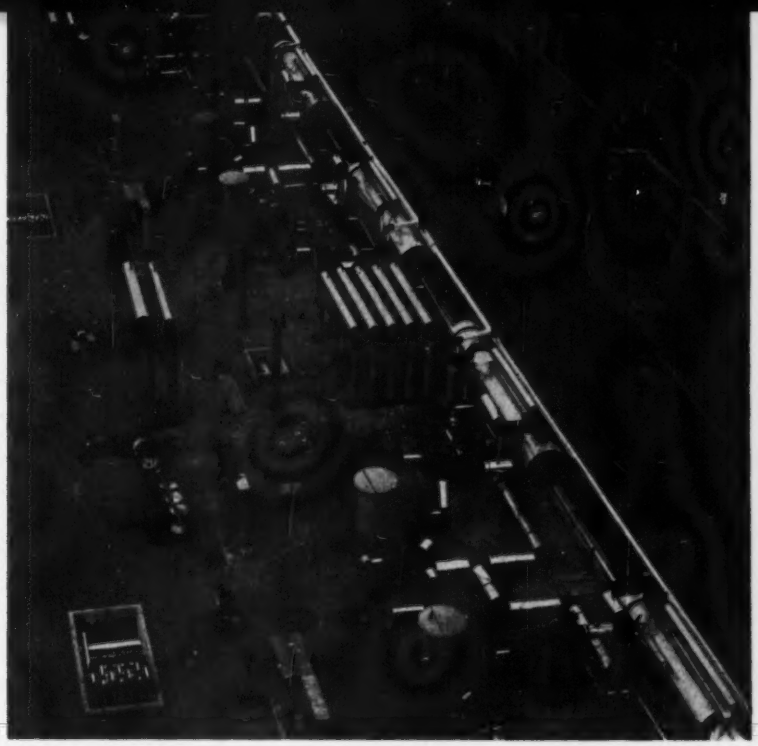
Unbalanced currents result in an induction motor when supplied with unbalanced voltage, and current unbalance increases with load. In the example we're discussing, 99.6% positive-sequence voltage is supplied to motor No. 1 and 11.5% negative-sequence voltage to motor No. 2. At full load the current of motor No. 1 is very close to 100% of nameplate value; current of motor No. 2 is (11.5%/100) x 6.5 or 75% of nameplate current for full load. Current in phase *a* of the actual motor is the vector sum of the phase-*a* positive-sequence current of motor No. 1 and negative-sequence current of motor No. 2, and similarly for the other phases. In our example the line currents for full load are 165%, 125% and 65%. It can be seen that line-current unbalance is much greater than the voltage unbalance which causes it.

Motor heating is increased by unbalanced voltage. Additional motor losses result in higher than normal temperatures for a given load. Large phase-current unbalance is important. A current of 165% of normal as found in the previous discussion causes 275% of normal winding loss or heat generation for the particular phase involved. Measured heat of highest-current phase may not be correspondingly as high because of heat flow.

Protection by standard methods intended for balanced-voltage operation may not be effective when voltage supply is unbalanced. If protective devices are set at 130% for lines *b* and *c* of Fig. 1 motor winding of phase *a* isn't protected from abnormal heating.

Noise and vibration problems may be caused or aggravated by operation of induction motors on unbalanced voltages. If voltage unbalance is carried to the limit where single-phase operation of a 3-phase motor occurs considerable vibration may result.

Two useful references are: *Symmetrical Components*, by Wagner and Evans, McGraw-Hill Book Co, Inc, N.Y.C.; *Operation of 3-Phase Induction Motors on Unbalanced Voltage*, by J E Williams, AIEE Trans. paper, 1954.



ROOF-TOP LOCATION of pump motors, fuel-oil heaters, relief and by-pass piping eliminates need for pump house. Setup cuts out pump-house cost and permits simpler, less-expensive piping arrangement in addition to freeing more space for Bunker C storage

Here's a way to get more space for oil-storage tanks located in crowded quarters . . .

Gear pumps boost tank-farm capacity

Tank farms in crowded cities are usually allocated just so much space and that's it. And this space must hold the tanks and all equipment—pumps, heaters, piping, pump house. So engineers face the question, "How do we get the greatest storage value from this space?" whenever they propose a city-located tank farm.

This was the problem at Consolidated Edison Company of New York's Hudson Avenue tank farm in New York City. Their solution: eliminate the pump house. Put pumps inside tanks, everything else on the roof. Plan added storage space and gave two extra benefits—it cut out cost of pump house and simplified the piping arrangement.

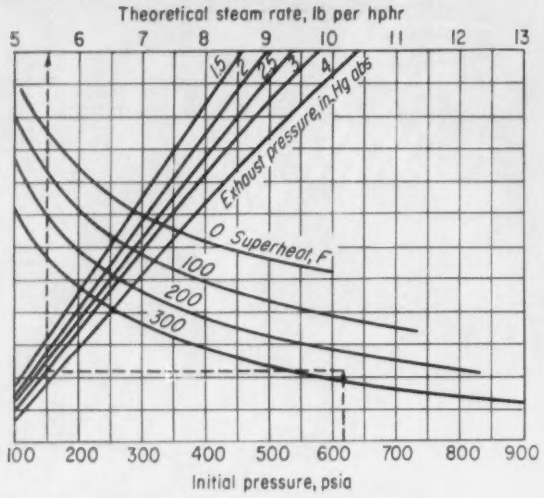
Design limits both on tanks and pumps were many. Space available for the farm was one city block. But city codes permitted no tanks higher than 15 ft above grade, and tide levels limited tank bottom to 15 ft below grade. Another headache was the low heat level of the fuel. Suction heating was out since steam lines, limited by city code to ten psig inside tanks, could not be properly drained because of high water level; electric heating cost too much. Oil would arrive at farm from nearby tanker dock already heated, at temperatures from 100 to 140 F with a viscosity rating of 3000 ssu at 122 F. But this was too thick for centrifugal pumps.

Vertical screw pump was the answer. Pumps, supplied by Sier Bath Gear & Pump Co, were originally designed to run in a horizontal position but were adapted for vertical operation in these tanks. Two pumps handle the load from each of four separate storage tanks and work continuously even when viscosity rises to 40,000 ssu, equivalent to 70-F fuel.

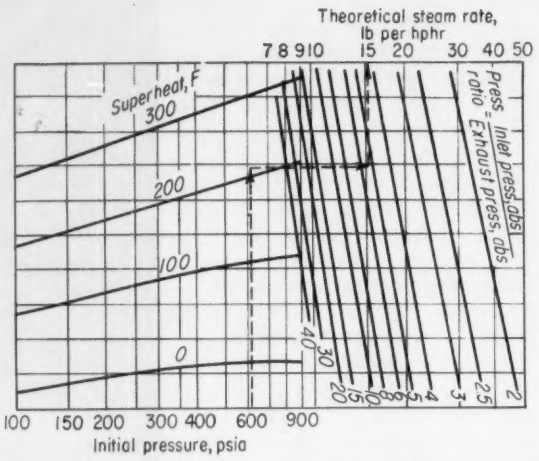
Both pumps run at the same time and each is sized to handle full load required from the tank, 500-gpm Bunker C. Since pumps are positive-displacement types, relief and by-pass piping sends excess fuel pumped out of the tank back again. With this arrangement there's no line pressure drop if one pump cuts out.

External lube system protects pump vitals and 30-ft drive shaft from foreign material in the fuel. Pump and shaft are hung from top of tank with shaft and thrust bearings encased in a pipe reaching the pump top. Oil is pumped from a roof-top reservoir to the pump impellers, up through the timing gear and support pipe and back to reservoir. There are no tank side supports or guides for the shaft and pipe—only guide is a notched plate under the pump casing that prevents excessive shaft and pump sway. Arrangement simplifies removing pumps for maintenance.

If temperature in the four 145x 85x30-ft tanks drops too low, oil from steam-heated roof-top discharge heaters can be fed back to tank bottoms. Heated oil is introduced into tanks between the two pumps of each set.


Theoretical steam rate, lb per hphr
5 6 7 8 9 10 11 12 13
Exhaust pressure, in. Hg abs
0 Superheat, F
100
200
300
100 200 300 400 500 600 700 800 900
Initial pressure, psia

1 Theoretical steam rate for condensing turbines depends on initial and exhaust pressures and steam superheat at the inlet


Theoretical steam rate, lb per hphr
7 8 9 10 15 20 30 40 50
Superheat, F
300
200
100
0
Press. ratio = Inlet press, abs / Exhaust press, abs
100 150 200 300 400 600 900
Initial pressure, psia

2 Theoretical steam rate for noncondensing turbines also depends on steam conditions; exhaust pressure is given as a ratio

To choose the proper turbine for given operating conditions we must have a way of getting quick answers. Here's a method that shows . . .

How to predict turbine performance

By RICHARD SHIFLER, Thermodynamic Design Engineer
Small Steam Turbine Department, General Electric Company

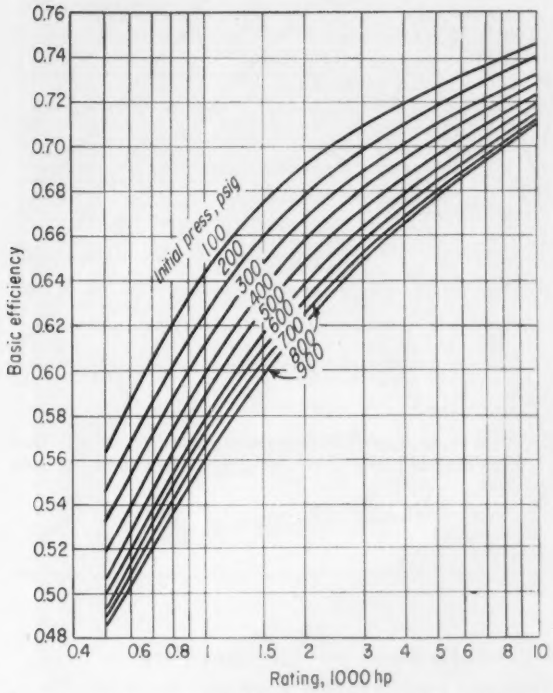
To easily compare alternative cycle arrangements using turbines we should have turbine performance predictions in a convenient form. Experience in selling and applying m-d turbines enables manufacturers to offer a fast estimating method for calculating performance. Efficiency level we give here has been found economically satisfactory for a wide variety of applications. Turbines to develop better or poorer performance than offered on this estimating base can be purchased at an appropriate adjustment in price.

Theoretical steam rate (TSR) measures the ideal flow of steam needed to produce a unit of energy output. TSR is the number of pounds of steam needed to produce one horsepower for one hour, or lb per hphr, when the steam flows through a 100%-efficient turbine. TSR depends only on steam conditions: initial pressure and temperature and exhaust pressure. TSR's vary over a wide range—from less than ten to hundreds of lb per hphr. They must be determined accurately because they are the base of the performance calculation. Fig. 1 and 2 gives TSR's in graphical form, accurate enough for initial estimating.

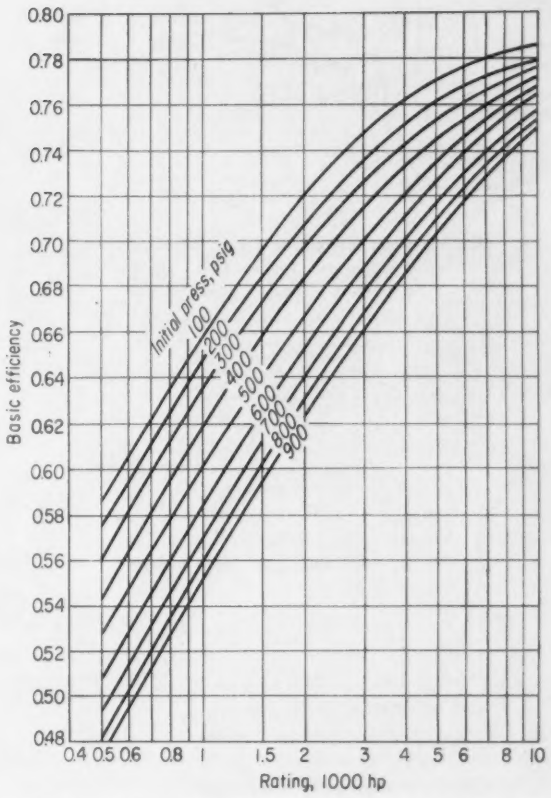
Basic efficiency for m-d turbines varies from about 50 to 80% for most steam conditions and applications. We learned in Part 1, POWER, Nov 1958, p 86, that typical stage efficiencies were higher for turbines with large nozzle areas. Basic efficiency for complete turbines runs higher for high ratings or low initial pressures because of the larger nozzle areas needed by these conditions. Fig. 3 and 4 show basic efficiencies for condensing and noncondensing turbines respectively.

Superheat in steam increases available energy and also improves turbine efficiency by reducing supersaturation and moisture losses. Fig. 5 gives superheat correction factor to apply to basic efficiency for condensing and noncondensing turbines. At higher initial superheats the gain for noncondensing turbines is less than for condensing units because of the smaller part of total expansion taking place in the wet region.

Speed. Limited nozzle area that proves practical for variable-speed turbines and fewer stages needed for higher speeds affect turbine efficiency as shown by *speed factor* in Fig. 6. Exhaust pressure and rating of condensing turbines determine nozzle



3 Basic efficiency of multistage condensing turbine varies with its hp rating and the steam pressure at the turbine throttle



4 Basic efficiency of multistage noncondensing turbines runs higher than in condensing steam turbines for the larger ratings

areas in the last few stages. To a great extent these set turbine's physical size and cost. Efficiencies for higher condensing exhaust pressures are better but steam rate may be poorer because of higher TSR.

Economic balance must be made between fuel costs and turbine and condenser capital costs. For most applications exhaust pressures in the range of 2- to 4-in. Hg abs are found to be best. Fig. 6 reflects effect of both rating and exhaust pressure for condensing turbines. For noncondensing turbines horsepower alone is the more important factor, no reference to exhaust pressure being needed.

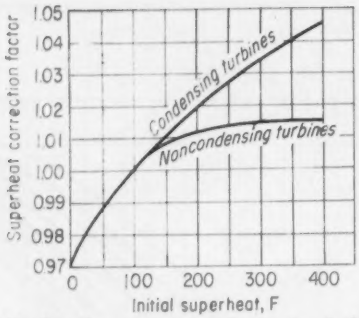
Pressure ratio. Noncondensing turbine efficiency becomes poorer at high ratios of exhaust to inlet pressure because of the greater percentage of throttling loss in the governing valves. At low pressure ratio efficiency drops to limit the number of stages and reduce the cost of the turbine. Fig. 7 modifies basic efficiency of noncondensing turbines for these effects.

Condensing turbines apply where shaft power must be supplied without concurrent demand for process steam. These units, however, may efficiently use steam produced as a process byproduct. High efficiency in condensing turbines usually proves important because heat rejected to cooling water seldom can be used. In their first year of operation m-d turbines may use heat of a value equal to the turbine's initial cost.

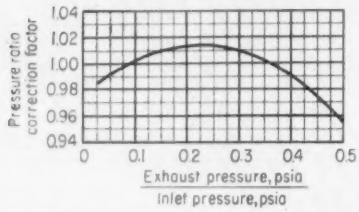
Noncondensing turbines apply where demand for shaft power and process steam coincide. A deficiency of steam for process supply at a noncondensing turbine exhaust may be made up by throttling from main steam line at boiler pressure. Excess steam from the exhaust may be wasted by throttling to a lower pressure when shaft power need produces more steam than can be used by the process.

Noncondensing turbine efficiency is usually important because of large steam flows through turbine. When exhaust heat from a noncondensing turbine can be charged to a process, turbine's thermal efficiency may be as high as 90%.

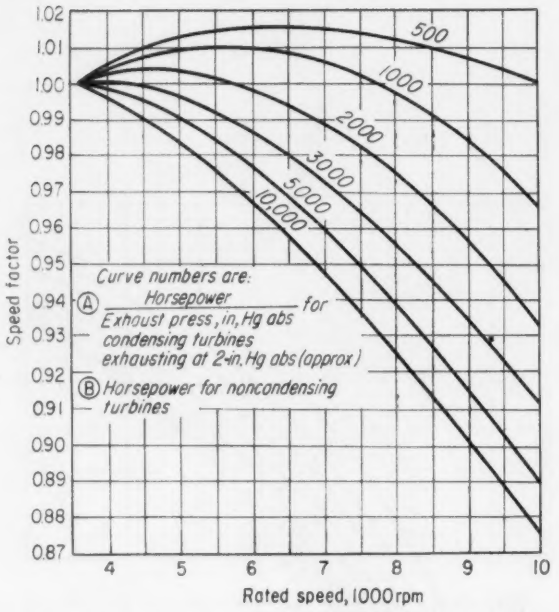
Performance estimate. Fig. 1 through 7 form basis for the method of quickly computing m-d turbine performance over a wide range of steam conditions and turbine ratings. Table 1 outlines steps for computing full-load performance of a 6000-hp condensing turbine running at 7000



5 Superheat correction factor for both types of turbine is based on 100 F



7 Pressure ratio correction applies only to the noncondensing type steam turbine



6 Speed factor depends on both shaft rpm and rating of turbine, or on ratio of rating to exhaust pressure for condensing units

rpm and using steam at 600 psig and 750 F and exhausting it at 3-in. Hg abs. Check each of the first four items with given conditions and corresponding graph. Note that TSR is divided by all efficiencies and factors to get estimated steam rate.

Table 2 outlines steps for computing full-load performance of a 6000-hp noncondensing turbine running at 7000 rpm and using steam at 600 psig and 700 F and exhausting to a process at 100 psig. This unit needs one more step than the condensing unit to find the answer.

After completing initial studies and fixing application requirements, consult turbine manufacturer for advice and firm quotations of price and steam rate. Initial inquiry should give rated load and speed, type of driven equipment, part loads and speeds, speed range, steam conditions, steam-cost evaluation, accessories wanted.

Turbines may be built and quoted for present steam conditions and different future steam conditions if known at time of manufacture. Specify both if you can for an overall saving. Steam rate is guaranteed at only one operating condition and predicted for others.

Next part will give curves for automatic-extraction turbines.

Table 1—Estimated performance of straight condensing turbine

At rated load of 6000 hp, speed of 7000 rpm; throttle steam at 600 psig, 750 F (261-F superheat); exhaust at 3-in. Hg abs

(1) Theoretical steam rate, Fig. 1, at 615 psia, 261 F, 3-in. Hg abs	5.50 lb per hphr
(2) Basic efficiency, Fig. 3, at 6000 hp and 600 psig	0.698
(3) Superheat factor, Fig. 5, at 261-F superheat	1.029
(4) Speed factor, Fig. 6, at 7000 rpm and (6000 hp/3-in. Hg abs = 2000)	0.989

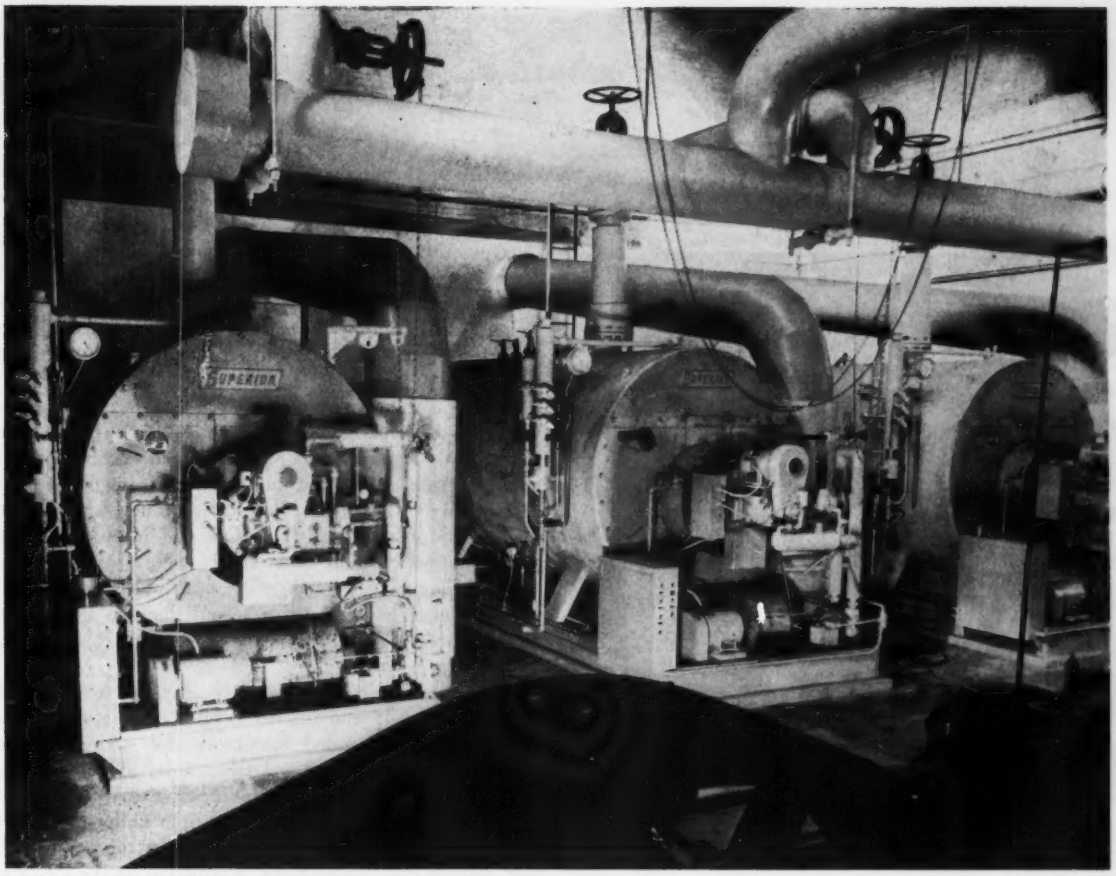
$$\text{Estimated steam rate} = \frac{\text{TSR}}{\text{Efficiency}} = \frac{5.50}{0.698 \times 1.029 \times 0.989} = 7.75 \text{ lb per hphr}$$

Table 2—Estimated performance of straight noncondensing turbine

At rated load of 6000 hp, speed of 7000 rpm; throttle steam at 600 psig, 700 F (211-F superheat); exhaust at 100 psig

(1) Theoretical steam rate, Fig. 2, at 615 psia, 211-F superheat, P_1/P_e = 5.35	15.3 lb per hphr
(2) Basic efficiency, Fig. 4, at 6000 hp and 600 psig	0.74
(3) Superheat factor, Fig. 5, 211-F superheat	1.012
(4) Speed factor, Fig. 6, at 7000 rpm and 6000 hp	0.957
(5) Pressure-ratio factor, Fig. 7, at P_e/P_1 = 100+15/600+15 = 0.187	1.013

$$\text{Estimated steam rate} = \frac{\text{TSR}}{\text{Efficiency}} = \frac{15.3}{0.74 \times 1.012 \times 0.957 \times 1.013} = 21.1 \text{ lb per hphr}$$



PLANT MODERNIZATION centralized power services to cut our manpower needs. Three new, fully automatic steam generators carry plant process and heating load. Air compressors on opposite side of firing aisle allow one man to supervise entire plant operation

A hard look at our power services led to big savings

We solved a troublesome manpower problem and paid off our power-plant modernization in one year by checking plant process needs

By J H PASELL, Chief Design Engineer
and R JOHNSON, Plant Engineer
Morse Twist Drill & Machine Co
Division of Van Norman Industries Inc

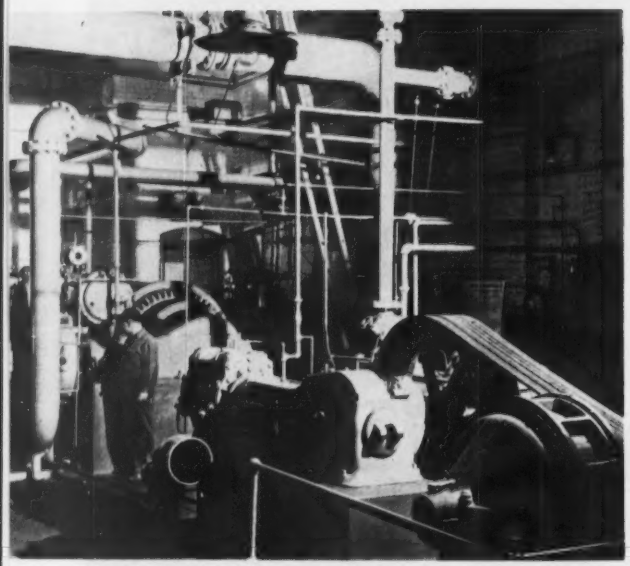
When does it pay to completely renovate a power plant if unit efficiency is already satisfactory? Our answer for Van Norman Industries' Morse Twist Drill & Machine Co plant in New Bedford, Mass. was: when you can clear up a vexing manpower problem and return your investment in one year. We found key to our solution, not in the boiler house, but in a critical appraisal of *in-process use* of all power services.

Our power plant contained a total of 600 hp in steam generators, supplying process and heating loads. Two air compressors located in the manufacturing area supplied plant compressed air. We also operated process-coolant refrigerating units and a centralized drinking-water system. This equipment operated satisfactorily and power-plant efficiency was quite respectable. Under these circumstances, why consider drastic modernization? The basic answer to this was manpower savings.

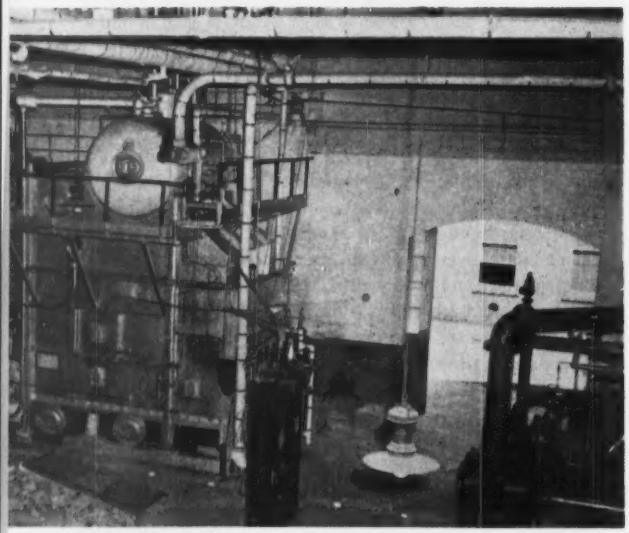
State regulations required licensed operators in the power plant for each shift. Decentralized air compressors required one operator, refrigerating units another man per shift. In general, power services demanded too much manpower, so overall power cost rose.

We found our solution to manpower problem out in

Centralized power services plus



AIR COMPRESSORS now located in boiler room handle process requirements. Air replaced high-pressure steam for power hammers



EXISTING BOILERS came out to make room for low-pressure units. Changing processes made high-pressure steam unnecessary

the main plant. Keeping in mind peak efficiency for overall power-services load, we examined electric power, compressed air and steam use throughout the plant.

High-pressure steam was needed only for a pair of large steam hammers and our mud-blast cabinets. Both items produced intermittent to occasional steam demand. Aside from steam-turbine driven auxiliaries in the power plant, all other steam was throttled down to 15 or 5 psig for process or heating load.

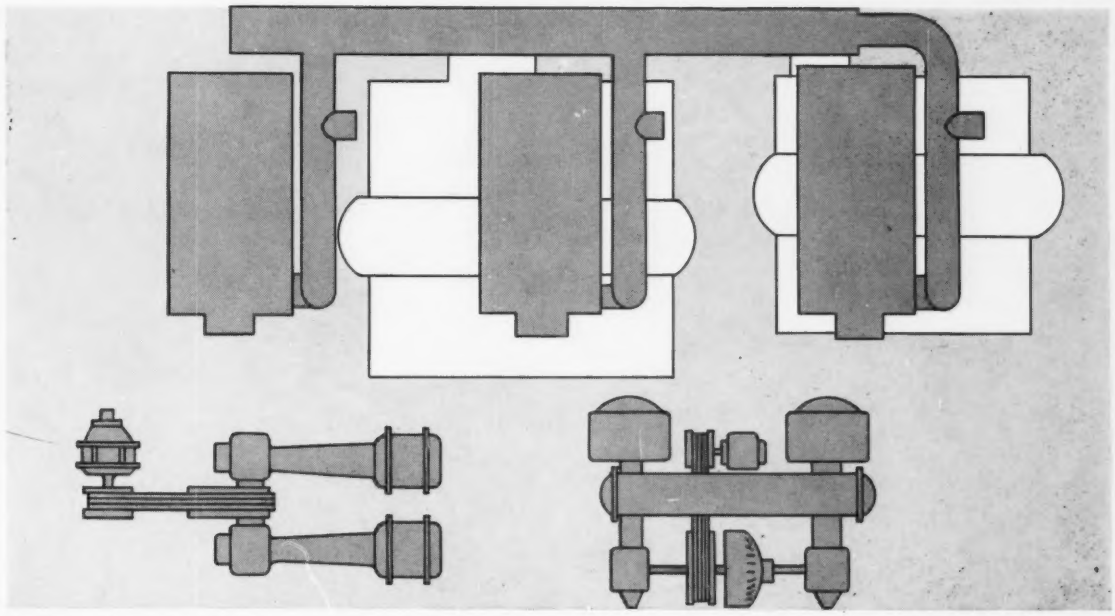
Here was a possible answer: Do away with the high-pressure steam load and convert boilers to fully automatic low-pressure operation. Under these conditions boilers could operate unattended and we would not need a full staff of licensed operators. Purchase of a new air-operated hammer would eliminate one load and installation of a small automatic steam generator could supply mud-blast cabinet demand. Converting steam-turbine driven auxiliaries to electric-motor drive would then do away with all high-pressure steam and actually increase operating efficiency.

Reducing operating pressure for the two existing boilers to 15 psig and installing fully automatic controls would allow unattended operation and savings up to $30,000 per year in reduced labor costs alone. Existing boilers' capacity at 15 psig would be approximately one-half the design capacity. The bent-tube boiler originally capable of 17,000 lb per hr would, under the new condition, deliver only 9500. Steam production by the straight-tube boiler would drop from 27,000 to 15,000 lb per hr. This meant that in extremely cold weather we would need both boilers at full capacity to furnish 20,000 lb per hr needed to heat plant and furnish process steam. We would have no spare in case of trouble during the cold season.

In addition to this lack of reserve capacity, we would need to alter steam-atomizing oil burners and steam-turbine blowers, put in larger safety valves, install new soot blowers and furnish compressed air for operating them. And we could only use one of two available burners per boiler, since boiler code does not allow fully automatic operation with a 2-burner installation. But all of these changes could be made satisfactorily at a cost of approximately $15,000 for both boilers.

Biggest stumbling block in proposed conversion would result in continuous expense to the company and, by itself, made us decide not to convert our present boilers. Dew point of our 4%-sulfur No. 6 oil is approximately 240 F. This temperature is almost exactly the vaporization temperature of 15-lb steam. So tube surfaces would be at 240 F and cause condensation of the sulfur-laden gases. Corrosion resulting from this condensation would inevitably require boiler retubing, conceivably on an annual basis, costing well over $1000 a year. There would also be an efficiency loss from corrosive effects which cannot be calculated accurately, but would increase our steam-production costs. Only practical method of eliminating excessive corrosion would be switching to No. 4 or 5 oil, with a stipulation that it must not contain

fully automatic steam-generator operation cut manpower requirements



COMPACT LAYOUT of modernized power plant permits supervision of three steam generators, two air compressors by one operator. High-pressure units, white outlines, would develop less than 400 hp at reduced pressure. Three new units totaled 600 hp at 15 psi

over 1% sulfur. This would rate as a premium oil and would at least double our fuel cost. Cleanest conversion would be to gas, but best rate we could obtain was five times the cost of oil.

Low-pressure operation offered such sizable savings that we decided to replace our high-pressure units. We installed three 200-hp units burning No. 6 oil, any two capable of carrying the coldest weather load. Price of the three units delivered to New Bedford was $28,470. To this investment add the cost of electrifying our hot-water circulating pump and boiler-feed pump and changing steam lines. This brought total cost of the conversion to $50,000. But this expenditure was justified: we eliminated all licensed personnel in several categories and easily combined operation of the refrigeration coolant, oil pumping, air compressors and boiler room so they could be handled by one man per shift, working under a group leader also in charge of the pipe shop. Units are all equipped with alarm systems and operate automatically, so our standby costs were cut to regular watchman's service necessary when plant is not in operation.

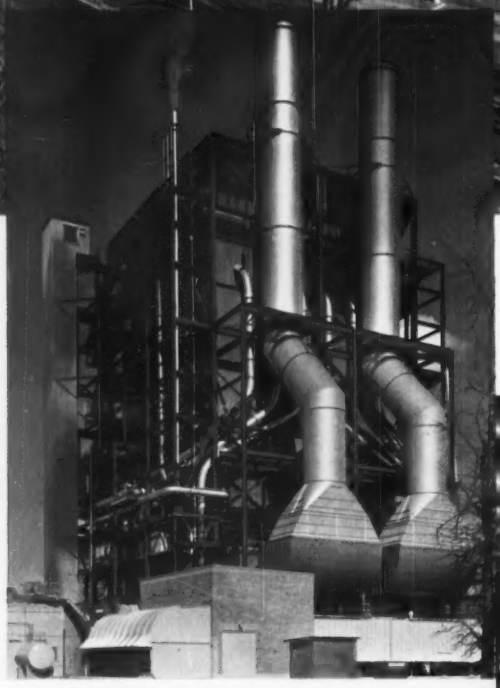
From the labor standpoint, we initially had 11 men in the power plant and pipe shop. We were required to hire at least one first- or second-class steam engineer to be in charge of the plant, a third-class licensed engineer as an assistant together with four licensed firemen to stand watches seven days a week, 365 days a year. We now have only four men for 2-shift operation and five men for 3-shift. Installation of the 15-psig units produced a direct labor saving of $36,430 on 2-shift operation.

In order to complete unification of these service departments and assure a maximum labor efficiency, we moved the two air compressors to the new boiler-room floor and installed the electrical dept in the switchboard room where all electrical distribution is located. We use the boiler-room attendant as an electrician's helper in cleaning and oiling motors. We eliminated a 20-year-old cooling tower and piped cooling water for all air-conditioning and compressor use from our main reservoir—system is spring-fed and virtually inexhaustable as far as the amount of water necessary for processes is concerned. We replaced the 20-year-old chilled-water compressor with a new liquid chiller similar to one recently installed for brine cooling. This unit handles flute-grinding coolant. Drinking-water fountains were decentralized and replaced with individual electrical units. Change in the drinking-water system had an added advantage—trouble in any one unit does not affect the remaining units.

Total cost for our plant conversion came to $58,000. After one year of operation we took a backward look at operating costs. We had estimated operational savings of $39,000, but found our labor and associated costs down more than $45,000. In addition, we showed a solid $12,803 saving in fuel and electric power costs. Our total savings of $58,396 more than covered the cost of modernizing. Our hard look at plant needs paid off.

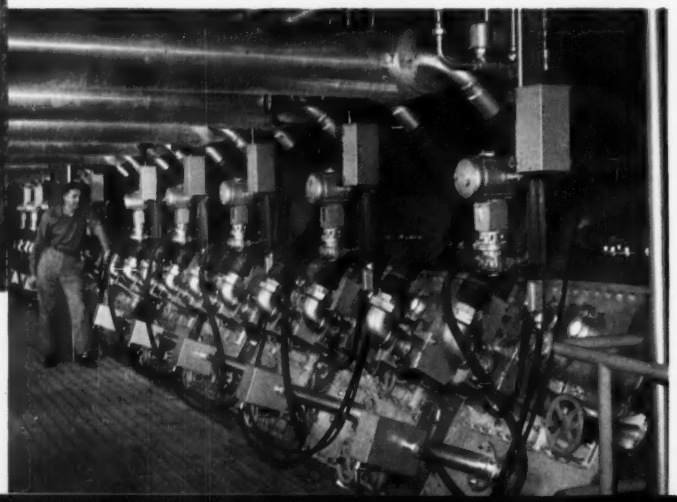
One TURBO FURNACE

The Riley Turbo Furnace Boiler is dominant structure at Sterlington Steam Electric Station near Monroe, Louisiana.



Weather resistant, colorful porcelainized panelling covers setting buckstays.

Ten of twenty Riley Directional Flame Turbo Furnace Burners. Opposed firing produces turbulent flame at uniform level across full 56 feet of furnace width. Each burner is equipped with remote automatic shut-off and flame sensing devices.



Leads to Another-

Performance at Sterlington, La. Is Basis For Decision To Install 1,650,000 lb/hr Turbo Furnace Boiler At Push-Button Operated Little Gypsy Steam Electric Station.

Louisiana Power & Light Company's new Little Gypsy Station is scheduled to go into operation early in 1961. This pioneering plant will be completely push-button operated. The design of the 1,650,000 lb/hr Riley Turbo Furnace to be installed is based upon the following exceptional operating characteristics of the 1,550,000 lb/hr Turbo Furnace at Sterlington Steam Electric Station.

Low air heater exit gas temperatures — high unit efficiency.

Low forced draft fan pressures — low auxiliary power.

A flat superheater and reheater metal temperature traverse across full furnace width.

Primary and reheat temperatures maintained from below 50% load to full load.

With bottom firing — full utilization of water wall surfaces.

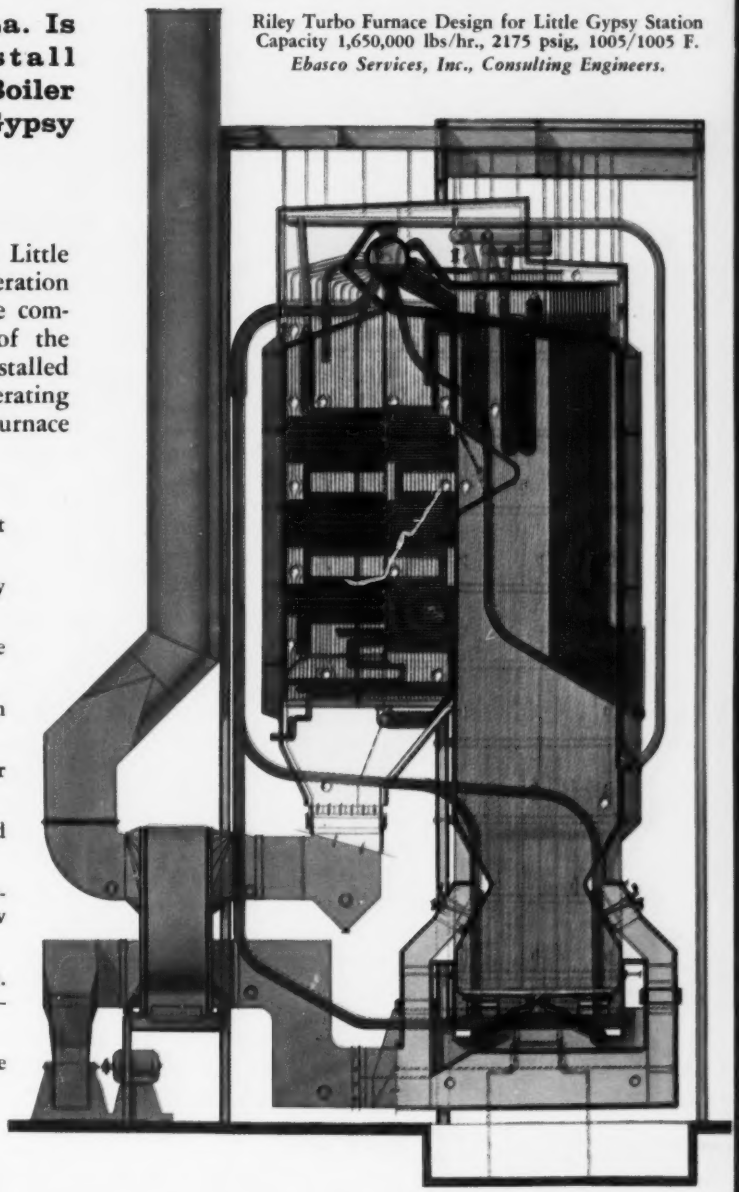
One level firing provides ease of observation and operation.

Gas burns with luminous flame with similar furnace temperatures as coal — hence, quick and low cost conversion to coal firing is possible.

With coal firing flyash is reduced to a minimum. With continuous slag tapping and reinjection — carbon loss is negligible.

With coal firing an exceptionally clean furnace is maintained.

Riley Turbo Furnace Design for Little Gypsy Station
Capacity 1,650,000 lbs/hr., 2175 psig, 1005/1005 F.
Ebasco Services, Inc., Consulting Engineers.



Monitoring at Sterlington Sets Stage For Complete Automation at Little Gypsy

At Sterlington, digital scanning, logging and computation of temperature conditions and other operating factors of furnace, boiler, turbine, generator, feedwater, and auxiliaries are the basic elements for complete automation of the Little Gypsy Steam Electric Station. Procedure, with audible and visible alarms, enables one operator in a centralized control room to make proper decisions for safe and efficient operation of entire plant. The operating characteristics of Riley Turbo Furnace Boilers are ideal for automatic push-button plant operation.

A survey of your plant by qualified consulting engineers could show ways of making substantial savings in your power costs.

RILEY

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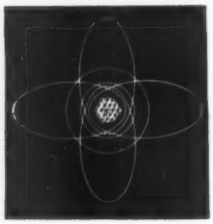
RILEY STOKER CORPORATION, WORCESTER, MASS.

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St Louis, St. Paul, Syracuse, Worcester.



Nuclear notes

By B G A SKROTZKI, Associate Editor

Reprocessing equipment for spent fuel elements that will be received from power reactors now being built is being engineered by General Electric Company for the Hanford Works in Washington. The $6-million project will be ready by early 1961. Up to 150 tons of widely diversified fuel material with as much as 5% enrichment will be handled. Fuel elements will be in many sizes and shapes, as uranium alloy or oxide, clad in aluminum, zirconium and stainless steel.

Advanced Epithermal Thorium Reactor (AETR) using thorium-uranium alloy fuel and a beryllium or graphite moderator is being studied by Atomics International for Southwest Atomic Energy Associates. The AETR will use sodium coolant. First phase of the study for a 360-mwe plant covering design and analysis of core and blanket layouts has been completed. Next phase will test reactor-core mockups to obtain physics measurements. The SAEA consists of 15 investor-owned electric utilities in Arkansas, Kansas, Louisiana, Mississippi, Missouri, Oklahoma and Texas.

Boiling-sulfur-cooled reactor will be studied for AEC by Aerojet General Nucleonics if contact negotiations now under way are concluded successfully. Sulfur boiling at about 1200 F promises a high-efficiency reactor if the engineering problems can be solved. This unsolicited proposal was among 11 received by AEC during period from Sept 1, 1958 to Feb 28, 1959. Unsolicited proposals for advanced concepts are reviewed by AEC on Sept 1 and March 1 every year.

Polyethylene plastic for radiation shielding is first used on a large practical scale in the N S Savannah. Containment vessel surrounding the reactor system has a 6-in. layer of polyethylene over a 6-in. layer of lead.

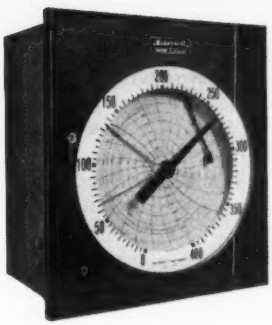
Nuclear-servicing barge will be built by Todd Shipyards under contract to AEC-Maritime Administration for the N S Savannah. The nonpropelled barge will be used for ship maintenance, refueling and waste-handling operations. It will have a highly compartmented hull for maxium stability and buoyancy. An amidships hold will possibly store expended fuel elements. Barge will also process radioactive liquid and solid wastes and prepare them for disposal.

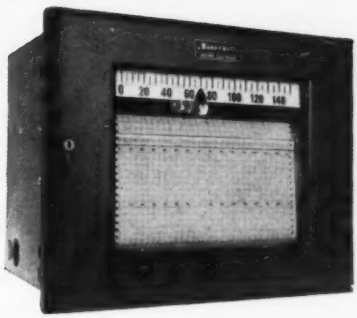
Indian Point nuclear-power station of Consolidated Edison Company of N. Y., Inc, will have its instrumentation and control supplied by Bailey Meter Company. They have selected General Electric Company to design and build the nuclear instrumentation and controls. These will use transistors in driving control rods automatically. System will use ten channels of neutron-monitoring instruments including startup channels, intermediate-range channels, log-N period channels and power-level flux-monitoring channels. Each channel can scram the reactor.

New booklet *Research and Development in Reactor Safety* describes work being done in AEC's reactor-safety program. Four areas are covered: (1) kinetics and control, the SPERI series of experiments, KEWB experiments, the EBR-1 fast reactor experiments, reactor safety devices (2) potential reactions, fission-product release, metal-water reactions and metal-gas reactions (3) containment, primary-reactor, secondary-reactor containment, missiles, earthquake studies (4) bibliography. The 66-p book costs 65 cents from Superintendent of Documents, U.S. Govt Printing Office, Washington 25, D.C.

New Constant Voltage Unit makes *ElectroniK* instruments better than ever

by eliminating these problems



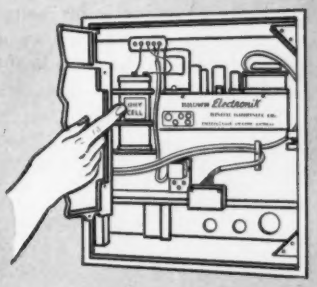


All new Precision Line *ElectroniK* circular and strip chart instruments have the new Honeywell Constant Voltage Unit that accurately regulates d-c reference supply to the measuring circuit. No more batteries, standard cells or standardizing mechanisms . . . and no more of the problems they pose.

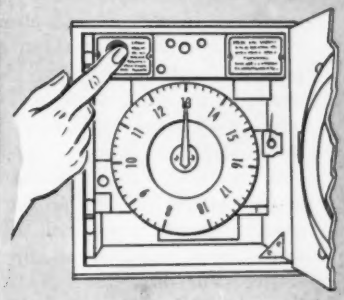
The Constant Voltage Unit delivers a constant, rectified voltage from line supply. It uses dependable Zener diodes and a reliable ambient temperature compensator.

This latest improvement in *ElectroniK* instruments assures even greater dependability, and less maintenance, and is still another reason why *ElectroniK* instruments are your best value in measurement and control. Get full details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

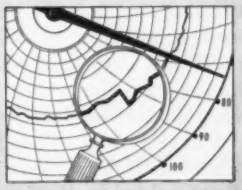
MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.



No batteries **to replace . . . no recording or control deviation due to low battery voltage.**



No button **to push on the instrument for standardization . . . no false readings because of failure to standardize.**



No blanks or shifts **in the instrument's response to variables. You get complete continuity of recording and control.**

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First in Control

For more facts circle 246 on Reader Service card, p 121

Reserved for your comment

BOB BELLAS, Associate Editor

Liquid diet

Well done. "Thermal liquids match process heating needs" (August, pp 53-58) is a very comprehensive article. I am sure that this discussion will be well received by your readers. Many articles have highlighted vapor-phase or liquid-phase heating, but few have attempted to give advantages and disadvantages of each as you have done so well.

Process heating is becoming more and more refined. This is evidenced to us by the increasing number of inquiries for a heat-transfer medium that will do a particular job. And with the growing variety of thermal liquids available for process heating today, an article has been needed that would review highlights of each and illustrate areas where each is applicable.

We at the Dow Chemical Co are very proud of the acceptance *Dowtherm A* (Dow heat-transfer medium) has had in the quarter of the century that it has been on the market. Its properties, usage and type of equipment are well summarized in your article. However, I'd like to comment briefly on your references to *Dowtherm*. The word "*Dowtherm*" is a trademark of the Dow Chemical Co and is used to designate various heat-transfer media.

A trademark to remain a trademark must be properly used by both the company owning the word and the public using it. If this isn't done, the trademark's value can be lost. Some examples of trademarks lost through improper usage: aspirin, deep freeze, escalator, cellophane. Each trademark in your article has been properly identified with its generic name as is required. However, a trademark word cannot be used as an adjective nor in the possessive. For this reason your article isn't correct in saying "*Dowtherm* vaporizer" or "*Dowtherm's* properties." These should be "vaporizer for *Dowtherm*" and "properties of *Dowtherm*."

Your article mentions firetube and watertube units used as natural-circulation vaporizers for *Dowtherm*. Your readers may also be interested in knowing that forced-circulation vaporizers can be used with *Dowtherm*. When such a forced-circulation heater is used a flash tank is incorporated with the heater. Flash tank is eliminated, of course, when *Dowtherm* is used in liquid phase.

I hope POWER will follow up with discussion of other heat-transfer media as they're developed and their various applications, together with more on types of equipment used in such services.

A R CONANT, *Engineering Chemicals Sales*
Dow Chemical Co, Midland, Mich.

. . . In connection with this interesting article, we'd like to add a few thoughts concerned with heat-transfer which might be of value to your readers.

Performance and life of a petroleum heat-transfer fluid is largely dependent on design of the system in which it is used. For example, to obtain long fluid life the system must be arranged to prevent high-temperature fluid contact with air. This eliminates rapid rates of fluid oxidation that otherwise would shorten fluid life and cause deposits. Consequently petroleum heat-transfer fluids are used in closed systems that include a "cold-oil expansion tank."

In general, temperature of oil in the expansion tank should not exceed 130 F. Fluid temperature is largely influenced by tank's size and location and size of connected piping. Roughly, the covered expansion tank should have a capacity of about one-half of that of the entire system. This is sufficient for expansion of fluid heated to 600 F and at the same time assures the tank remaining at least one-quarter full when the system is cold. Smaller tanks can be used when operating temperature is lower. The tank should be elevated and located so fluid in it will not get hot. It should be connected to system's coolest part, usually to circulating-pump suction piping. Connecting piping should be sized to prevent appreciable convection currents that would heat fluid in the tank.

Mobiltherm 600 and *Mobiltherm Light* are petroleum fluids that have been so changed by refining techniques that they are exceptionally resistant to thermal deterioration at high temperatures. *Mobiltherm 600* may be used in systems operating at 600 F, *Mobiltherm Light* may be used up to 500 F.

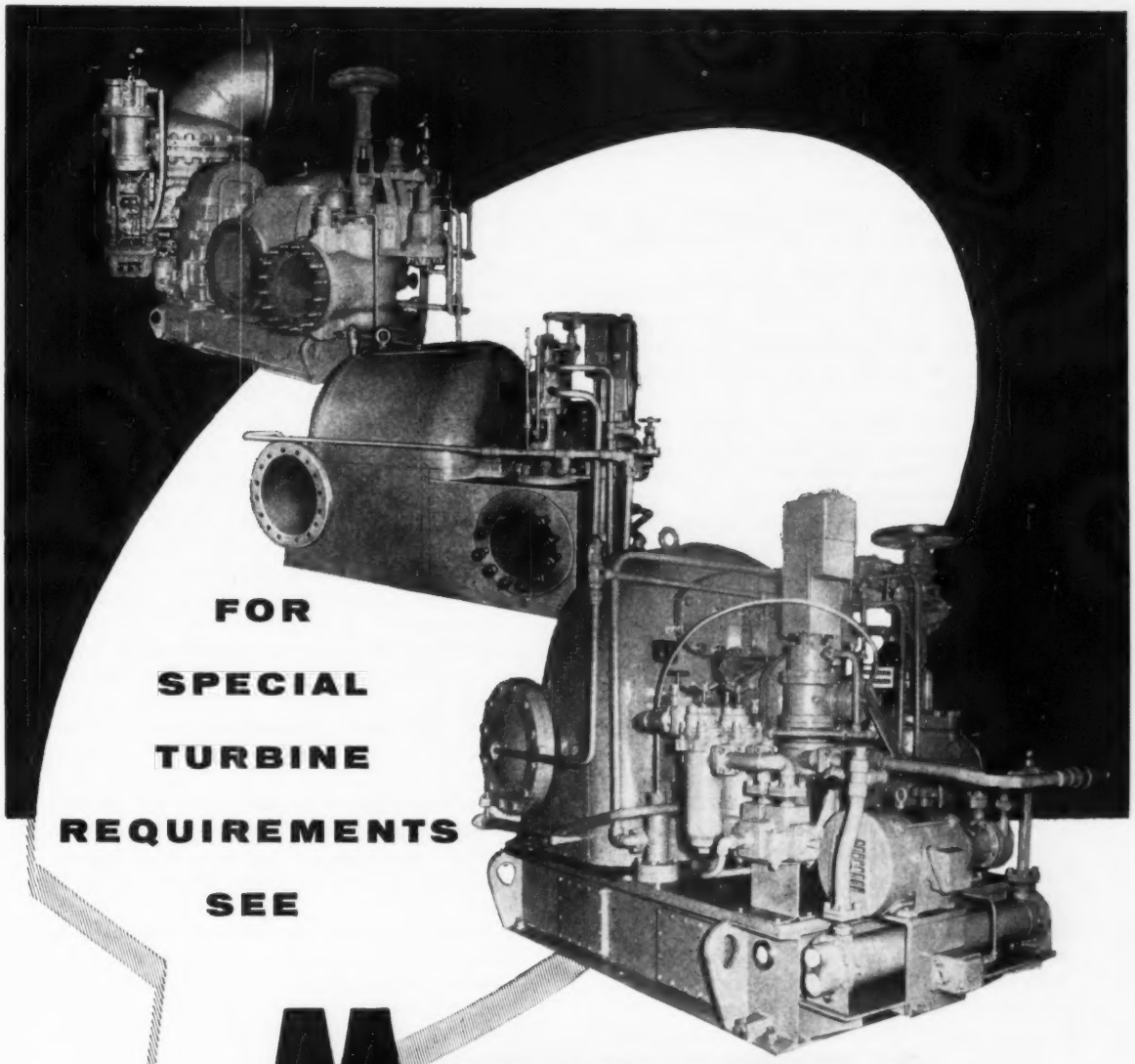
Article seems to attach some importance to high flash point temperatures. This property of the fluid does not indicate its suitability as a heat-transfer medium nor can it be used as a criteria of fire resistance. Although *Mobiltherm* products are not classed as fire resistant, fluid spraying from a leak on the hot side of a system (operating within recommended temperature range) will not flash or burn unless it contacts a source of ignition.

R B PURDY, *Socony Mobil Oil Co, Inc*
New York, N. Y.

EDITOR'S NOTE: *Caption for Fig. 2, (August, p 54) is in error in stating the fluid is "fire-resistant." Caption should read "One of the hydrocarbon heat-transfer fluids that resists thermal decomposition,* Mobiltherm 600, *can be used at temperatures up to 600 F and zero psig."*

. . . A timely and up-to-date treatment of a field which is expanding rapidly due to the need for high process temperatures and accurate temperature control which steam cannot meet economically.

We have been designing and installing thermal-liquid systems for over ten years, during which



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TURBINES

- Low Inlet Pressures
- High Back Pressures
- High Speeds
- Variable Speed Ranges
- Precise Control
- Multi-Valve Designs
- Double End Gear Drives
- Vertical Shaft Turbines

Our nearest representative will help you solve your turbine requirements. His name gladly sent on request.

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

Builders of Steam Power Equipment for Nearly a Century

For more facts circle 247 on Reader Service card, p 121

time we have found that extremely diverse applications exist for the many tried-and-true thermal liquids which are now available.

Our early thermal-liquid systems have been operating for over ten years without any system recharging. We feel that it shouldn't be necessary to recharge the fluid in a properly designed and operated system.

We have found that each fluid requires a different design approach. A common error is to carry over from one system (especially a vapor system) design practices which do not apply to another. Design of a thermal-liquid system for a particular application requires experience in design and operation of such a system as well as full knowledge of properties and an evaluation of pros and cons of available fluids. Many pitfalls await the unwary, but they're easy to avoid if one knows how.

It's important to recognize that some fluids can operate at low temperatures while others can not. Some present fire hazards, others are practically nonflammable. Some carbonize readily, others tend to decompose into gases or vapors. Some require expensive safety precautions and licensed operators in attendance, others do not. Some are suitable for open applications such as rotary joints and quick-disconnects, others produce unpleasant fumes at high temperatures. Some have low and some have high vapor pressures, resulting in pressure and vacuum problems. While we recognize the simplicity of vapor heating in certain situations, we have found that generally high heat-transfer coefficients and uniform temperatures can be more readily guaranteed with properly designed liquid-phase systems. Ease with which process temperature control can be achieved with liquids, especially when both heating and cooling are required to obtain control, generally favors liquids. A system we recently started up provides, with a single fluid, any controlled temperature from 40 to 400 F without high pressure and available to a wide variety of processing equipment in the plant.

Another important item to remember about thermal liquid systems: all components — heaters, pumps, heat exchangers, control valves, piping and equipment served must be designed, selected and properly integrated into the complete system. Otherwise the whole system may malfunction, resulting in poor operation, excessive maintenance or damage to equipment and the thermal liquid.

Safety of a thermal-liquid system and its simplicity of operation and maintenance are a joy, particularly to those accustomed to high-pressure steam with its traps, condensate return, water treatment, boiler scaling and other headaches.

I've seen a thermal-liquid heater continue to function and system continue to operate after one-third of the heater's waterwall tubes had sagged and burned off. They simply plugged themselves off without significant loss of fluid from the system. Insufficient circulation had caused localized overheating, but no unsafe condition resulted. I couldn't recommend this sort of operation, but picture the mess had it been a steam system.

FLOYD HASSELRIIS, *Chief Engineer, Industrial Div American Hydrotherm Corp*

George Edwards annex

I thoroughly enjoyed George Edwards' page (August, p 178) and I'd like to add some information developed since the study made by our organization. The General Services Administration has just completed an extensive study to determine what actual efficiencies can be obtained by adding air conditioning. This very complete study conducted over a 2-year period indicates that work output of employees in air-conditioned space is greater on an average by more than 9% of that of employees in similar space which is not air conditioned. When we match this against the 1½% efficiency required to pay for air conditioning it's quite evident that management is buying a "growth stock" which is better than anything currently on the big board.

Actually, we find that greatest potential dollar volume for the air-conditioning industry in future years lies in the area of existing industrial building facilities. What's more, we see coupled with this growth of air conditioning and improved efficiencies a trend toward mechanical plant-functions centralization within the building. This is being accomplished by use of our *Supervisory DataCenter*. Here, all plant-protection and security alarms, boiler and machinery alarms, critical temperatures, pressures, humidities, etc can be indicated and one operator can check the entire area from one central point.

W J ORTMAN, *Market Manager, Industrial Const Minneapolis-Honeywell Regulator Co*

. . . Did George's scouts give any details on that book that you can pass along in advance?

E TROSINO, *Capt, USNR, Springfield, Pa.*

EDITOR'S NOTE: *Yep.* Standard Plant Operator's Q & A, *2 vol. Subject matter (20 chapters): boilers, steam and diesel engines, turbines, pumps, refrigeration, electricity, electronics, instruments, compressed air, fuels and firing, etc. Has wealth of theoretical and practical info plus answers to questions asked in exams for stationary licenses (fireman to chief) in U.S. and Canada.*

When will copies be available? McGraw-Hill Book Co says around Sept 1 which is just about now.

Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

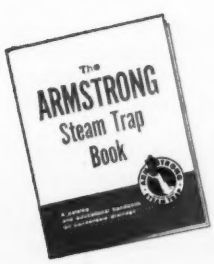
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

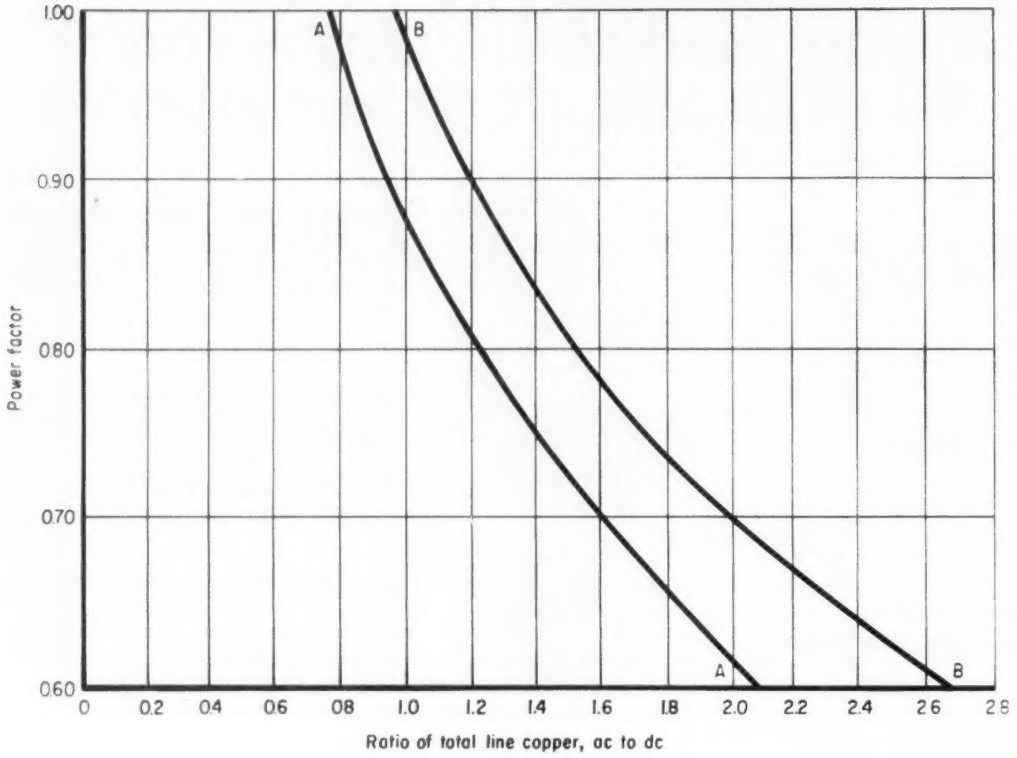
ARMSTRONG MACHINE WORKS

8123 Maple Street Three Rivers, Michigan

For more facts circle 248 on Reader Service card, p 121

Power's data sheet

No. 325



Copper ratios for ac and dc lines

Will you install local rectifiers or transmit dc? Many factors enter into your answer, including power loss and line size. To help you evaluate transmission types, chart above shows ratios of copper requirements for ac and dc when equal power is delivered with equal power loss. Curve *A* is based on equal voltages (220 or 250) for ac and dc lines while curve *B* is based on 220-v ac and 250-v dc lines. Both curves are based on 3-wire, 3-ph ac and 2-wire dc transmission.

Under equal conditions of voltage and line loss ac transmission line with unity power factor requires less copper than a dc line. But as power factor falls below unity, this advantage in favor of ac decreases and turns to disadvantage assuming equal distances and similar voltages.

In diagram locate power factor at left and trace horizontally to proper curve, then read down to copper ratio for the 3-wire ac line as compared to the 2-wire dc line.

With equal voltages, curve *A*, diagram shows unity power-factor ac line will require only 75% as much copper as dc line. For about 0.865 power factor copper ratio is 1.0. For still lower power factors the advantage is with dc, considering line loss only. Ac lines require twice as much copper (ratio = 2.0) as dc lines when power factor drops to about 0.61.

Voltage ratio represented by curve *B* (comparing 220-v ac with 250-v dc) shows only slight advantage for ac, even at unity power factor. When power factor drops below 0.70 copper ratio reaches 2.0.

This evaluation involves only transmission power loss at similar voltages. It does not take into account other factors, such as high voltage close to working face in mines and at heavy production centers. These may offset any disadvantage due to power loss.

W AMMONS, *Oak Ridge, Tenn.*

© POWER

News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: Trouble-shooting Packing Problems

Question:

How can you pinpoint the cause of a premature failure?

If you carefully examine used packing, a correct interpretation of the damage will often suggest exactly what caused a premature failure.

Generally speaking, the reasons fall into three areas: (a) the wrong size or style packing was selected for the particular service conditions, (b) the packing was not properly installed, or (c) the equipment requires maintenance. And any of these three conditions can not only result in premature packing failure . . . but can lead to other headaches resulting from poor performance of equipment.

Let us review some of the most common types of packing failures and their causes . . . easy to recognize through a careful inspection of the damaged packing.

1. ***Damage:*** Excessive reductions in the cross-section of the packing.

Possible cause: Bearing worn, or other shaft misalignment result in eccentric movement such as shaft "whip."

2. ***Damage:*** Wearing face of the rings dried and charred, but the rest of the packing is still in good condition.

Possible Cause: Either lack of proper lubrication, or the packing was not designed to withstand speed of movement involved, or the temperature range of service encountered.

J-M #7 Centripac® Packing shown here is designed specifically for single-stage centrifugal pumps in the process industries. Speeds to 3600 rpm; temperature to 500F.

3. ***Damage:*** One or more rings missing from set.

Possible Cause: Bottom of the stuffing box is badly worn, and allows the packing to extrude into the system, causing possible contamination.

4. ***Damage:*** Wear on outside diameter of the packing.

Possible Cause: Rings rotating with the shaft, or coming loose in the box. Choosing the correct size of packing will eliminate this problem.

To solve any sealing problem, call on your local J-M Packing Distributor or Johns-Manville representative. They are equipped to help you select the right packing for the job—one that insures long, trouble-free service. For information, write to Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

For more facts circle 249 on Reader Service card, p 121

Grinnell offers you a complete line of pipe hangers and supports

HERE ARE 24 TYPICAL EXAMPLES . . .

adj. swivel ring solid ring type fig. 101

adj. swivel ring split ring type fig. 104

split ring with socket fig. 107

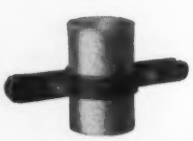
split ring with turnbuckle adjuster fig. 115

adj. wrought ring fig. 97

adj. wrought ring fig. 269

wrought pipe clamp fig. 212

adj. wrought clevis fig. 260


extension pipe or riser clamp fig. 261

extension split clamp hanger fig. 139

light welded-steel bracket fig. 194

standard U-bolt fig. 137

CB-Universal concrete insert fig. 282

wedge type concrete insert fig. 281

adj. wrought beam attachment fig. 252

adj. swinging hanger flange fig. 155

one hole clamp fig. 126

G-Clamp hanger fig. 92, 93

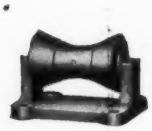
C-Clamp figs. 83, 84 85, 86, 87, 88

malleable beam clamp with extension piece fig. 229

universal side I-Beam clamp fig. 225

single pipe roll fig. 171

adj. steel yoke pipe roll fig. 181


pipe roll complete fig. 271

Look this page over. Shown are some of Grinnell's pipe hangers and supports. In the *complete* line will be found a solution to *any* pipe suspension problem you may have.

The maximum recommended load ratings for hangers have been established by thorough testing in the Grinnell Research and Development Laboratories. They are based on a minimum safety factor of 5, or the allowable stresses specified in the ASA Code for Pressure Piping.

Many of Grinnell's hangers are listed by the Underwriters' Laboratories, Inc., and they are approved by the Factory Mutual Laboratories for use in fire protection systems. For any pipe suspension problem, look to Grinnell.

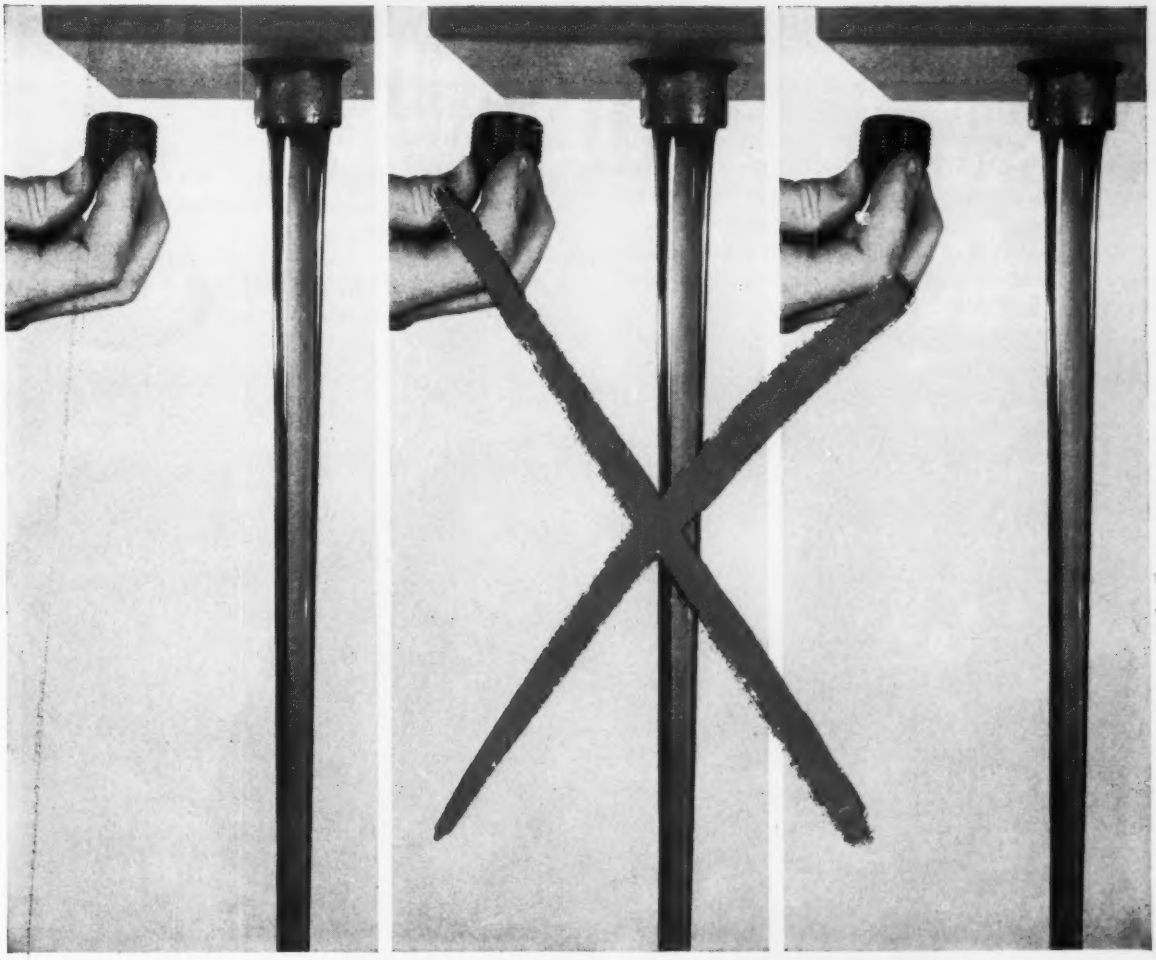
GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

Grinnell Company, Providence 1, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic fire protection systems • Amco air conditioning systems

For more facts circle 250 on Reader Service card, p 121



HOW TO CUT DRAIN PERIODS,
yet improve hydraulic performance!

Drain periods for a hydraulic system may be extended many times over by switching from straight mineral oils to a premium oil.

This has been proved time and again when the switch has been made to Texaco Regal Oil R&O without altering any other operating conditions.

It's obvious that draining hydraulic systems, cleaning, and replacing with new oil is costly. If one or more drainings can be eliminated the additional oil cost would be warranted.

Straight mineral oil may be satisfactory for some systems, but tests show that Regal Oil R&O can extend the interval between draining at considerable savings. This premium oil is formulated to resist oxidation, rust, foam, and wear.

And there's a bonus! When you do drain, you'll find the system in cleaner condition. Save again on make-ready.

The advantages of switching to Regal Oil R&O are so convincing that Texaco has made a film about it. We'll be happy to arrange a showing at your plant without obligation. Call the nearest of the more than 2,300 Texaco Distributing Plants, or write to:

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.
Tune In: Texaco Huntley-Brinkley Report, Mon.-Fri. — NBC-TV.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL
(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

For more facts circle 251 on Reader Service card, p 121

Choice of the leaders: K&M high-pressure insulations

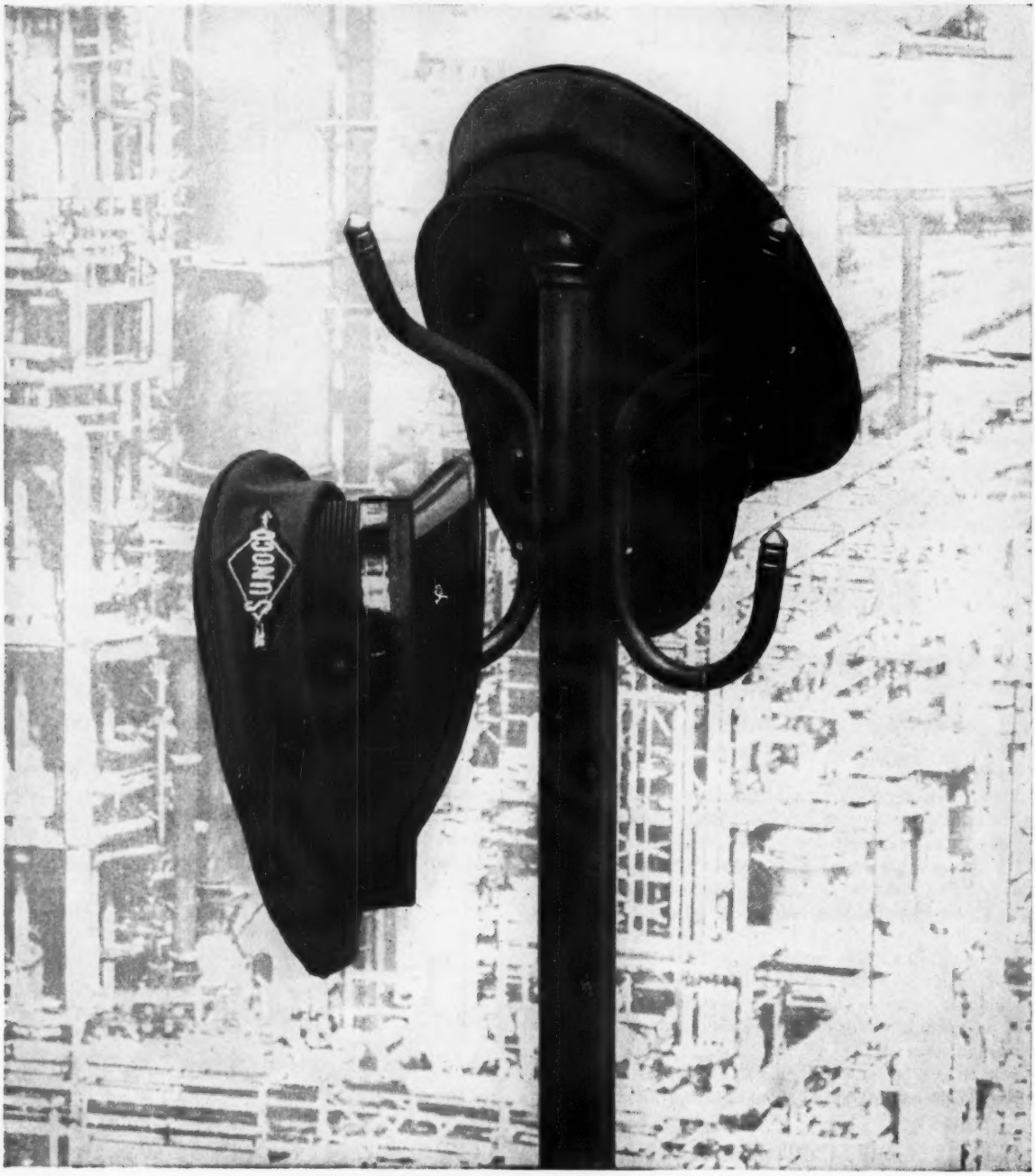
Where temperatures range up to 1350°F., you'll find leaders in all fields where heat control is important turning to "K&M" KaytherM. Because they can be *sure* with "K&M" KaytherM. There's no better insulation of its type. In low-pressure insulations, it does everything "85% Magnesia" does, and does it better. Composed of diatomaceous silica and quality asbestos fibers, "K&M" KaytherM is easily worked on the job, chemically stable, strong, and lightweight. Cement adheres readily.

"K&M" also manufactures a full line of Low-Pressure Insulations in pipe, sheet, and block forms, as well as in cements for all types of applications.

Whatever your insulation problems, you can rely on the eighty-five years of asbestos engineering that lies behind every "K&M" asbestos product.

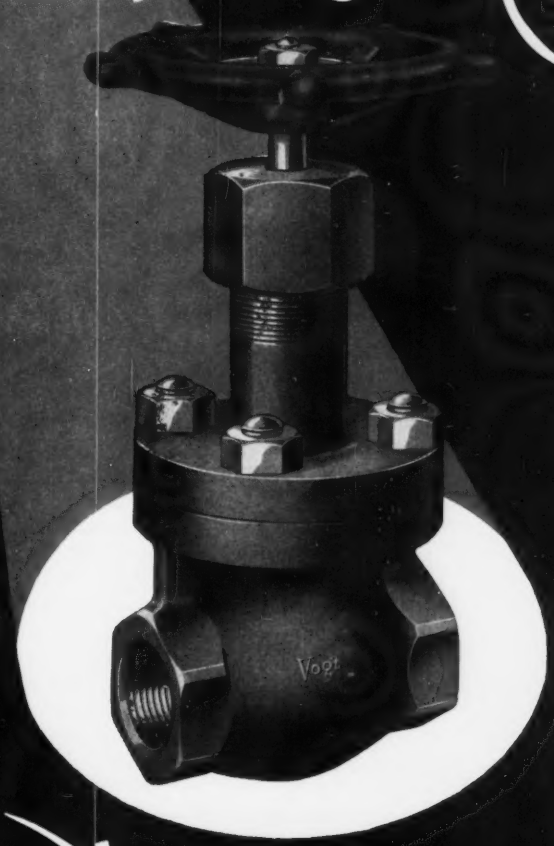
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K·M
BEST IN ASBESTOS



For more facts circle 252 on Reader Service card, p 121

Spotlighting 2 NEW VOGT VALVES



★

FORGED STEEL

INSIDE SCREW

Bolted Bonnet

GENERAL GP PURPOSE

GATE and GLOBE

VALVES

150-800 Pounds Service

2000 Pounds Cold, W.O.G.

Available from stock in ¼″ thru 2″ sizes and in both socket weld and screw ends.

CHECK THESE FEATURES

1. Forged steel pressure containing parts designed for light weight and brute strength.
2. Hard faced seats and hardened discs and wedges.
3. Spiral wound stainless steel or Monel gaskets to suit trim.
4. Extra deep stuffing box for long packing life.
5. Dished sure-grip handwheel.

Write for literature Dept. 24A-FP

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES

New York, Chicago, Cleveland, Dallas, Camden, N.J., St. Louis, Charleston, W.Va., Cincinnati

Vogt

GENERAL GP PURPOSE

Vogt VALVES & FITTINGS

FORGED STEEL

VALVES

For more facts circle 253 on Reader Service card, p 121

How'll you have your water?

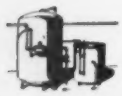
THE answer to "How'll you have your water?" depends on whether *you* are drinking it or your *plant* is drinking it. When the water is for boilers or industrial processes, it pays to be all-fired particular about every drop of it.

That's where Elgin comes in: Elgin methods and equipment can take your raw water and "make it over" into water with the exact characteristics you require. Since Elgin systems embrace all sound methods, Elgin recommendations are necessarily unbiased. The only question asked is, — what method gives exactly what is needed at the lowest possible cost?

And nearly a half century of specialization goes into the Elgin answer to that vital question!

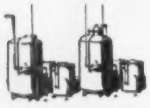
Some of the Elgin systems that may fit your needs are listed here . . . and there are many more that can be "tailored" to your specific needs.

Elgin experience is available to you through our district engineer. Write, and we will put him in touch with you . . . no cost or obligation whatever.

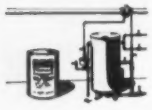


ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

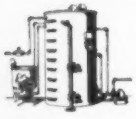
ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.



DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

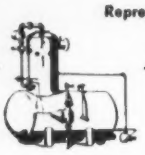


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

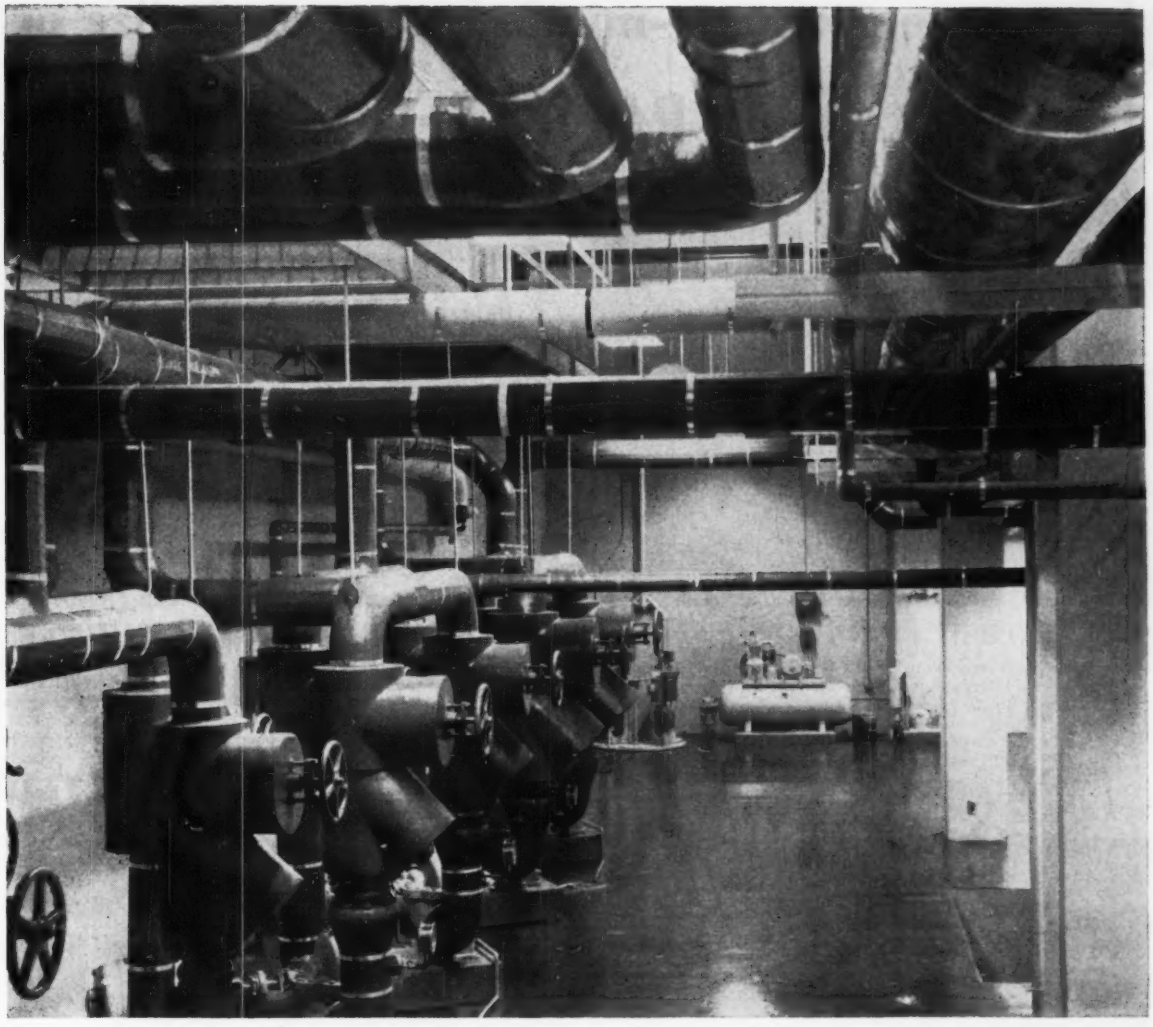
ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities — *In Canada: G. F. Sterne & Sons Ltd., Brantford*

ELGIN WATER CONDITIONING SINCE 1908

For more facts circle 254 on Reader Service card, p 121



Sure it's neat—but how can you tell it's safe?

The product tells you it's safe—USS National Seamless Steel Pipe and Tubes. The designer who insists on USS National Seamless is taking no chances. He wants to safeguard life and equipment, and to stop shutdowns because of unexpected failures.

Seamless shuts out all doubt. From end to end, it's one continuous piece of highest quality steel. No welds. No weaknesses. Absolute uniform wall strength. What's more, when a solid billet of steel is pierced, it's also critically explored. If the billet is successfully pierced, then every inch of the pipe is structurally sound.

Little wonder, then, that for industrial uses involving particularly severe or hazardous service, the first choice of engineers is seamless—in many cases, the use of seamless pipe is mandatory.

Remember this! USS National Seamless has ample ductility to permit bending, coiling and all other manipulations. USS National Seamless is not only the safest, but also the easiest to work with.

National Tube manufactures seamless pipe and tubes in a complete range of steel analyses from low carbon through the alloys up to and including stainless steel, to withstand the highest pressures and temperatures. A wide variety of sizes and wall thicknesses is available. Plan now to contact National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

The world's largest and most experienced manufacturer of tubular products

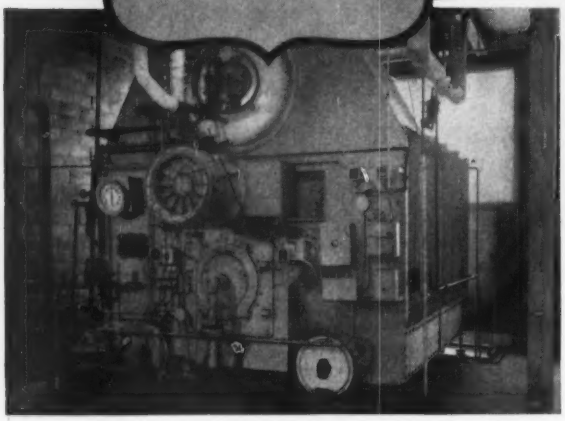
National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York United States Steel Supply Division, Chicago

For more facts circle 255 on Reader Service card, p 121

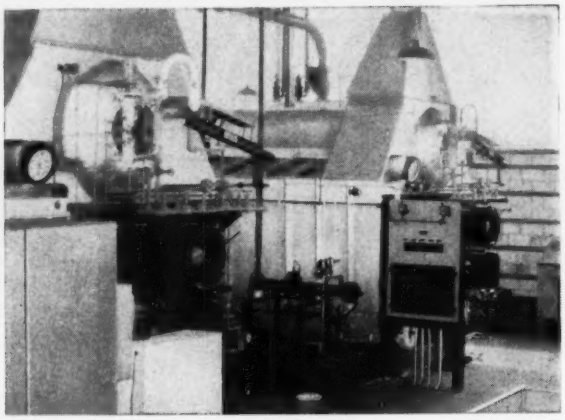
four more economy-minded users capitalize on

UNION PACKAGED BOILERS



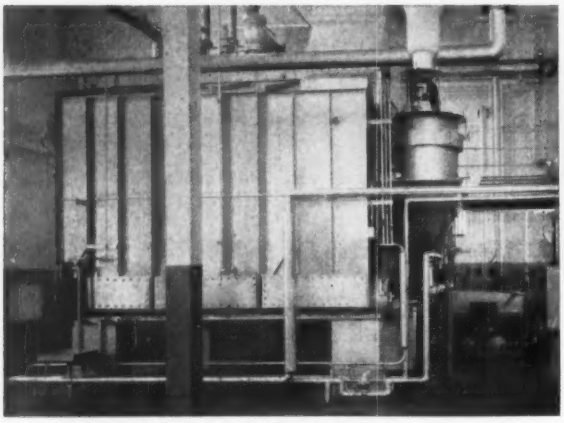
"NEEDED FLEXIBILITY" FOR EXPERIMENTAL CANNERY

The Green Giant Co., reputedly the world's largest packer of peas and corn, selected an 8,500 lb./hr. Union Packaged Boiler on the basis of "proven past performance of this type of unit." Installed to provide steam for its experimental processing plant, the MH Type Steam Generator provides "needed flexibility" to meet changing load demands of various process research projects.



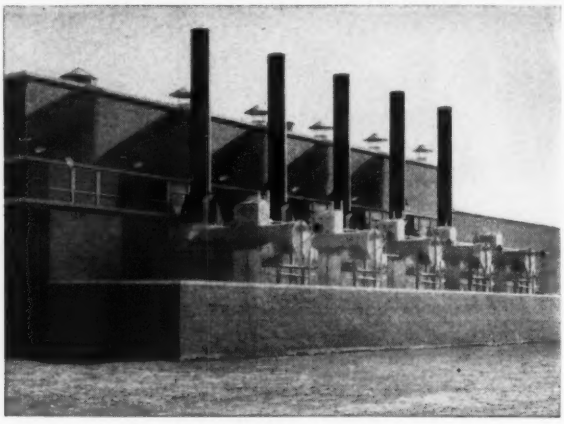
THRIFTY PERFORMANCE LEADS TO CHOICE OF SECOND MH

Following a policy of adopting "mechanical advances in machine design and automatic controls" to reduce costs, Mansfield Rubber Ltd. chose a 6,500 lb./hr. MH Boiler for its Ontario tire plant. "The performance and economy of this unit made the selection of a second quite simple," reports Mansfield. "We are particularly pleased with both boilers, especially when heavy steam is called for. They modulate well."



PICKED FOR SIMPLE, EASY INSTALLATION

Upon arrival, a new Union Packaged Boiler need only be positioned, connected up and lit off. In 1955, such simple installation was a big factor in the selection of this 20,000 lb./hr. unit for the new Hinde & Dauch plant at Eaton, Ohio. Delivering steam for space heat and processing, it plays an essential part in the manufacture of corrugated board for shipping boxes. This year, another MH (20,000 lb./hr.) was installed in H & D's Meriden, Conn. plant.



TWA BASE GETS STEAM THE MH WAY

Selected jointly by TWA management, city contractors and city engineers, this "MH" quintette serves the enormous overhaul base at Mid-Continent Airport, Kansas City, Mo. Individually rated at 33,000 lbs./hr., Union's five-boiler team provides space heat for the cavernous hangar and other buildings, plus a power generating source for various cleaning, plating and pumping operations.

FOR USEFUL DATA on Union Type MH Steam Generators (Capacities: 10,000-60,000 lbs./hr.) request illustrated Bulletin MH-353.

UNION IRON WORKS
ERIE, PENNSYLVANIA

Manufacturing Chemists for Over 100 Years

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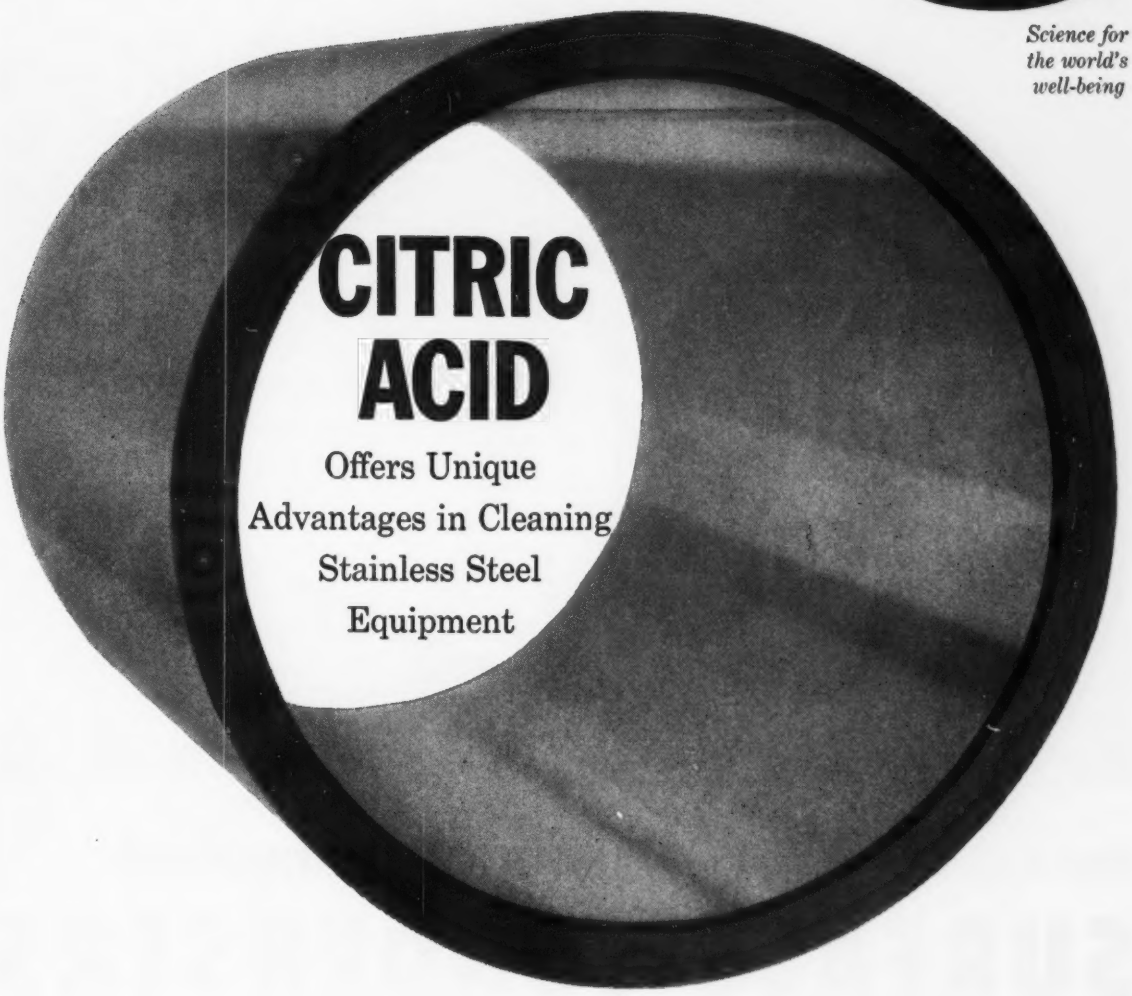

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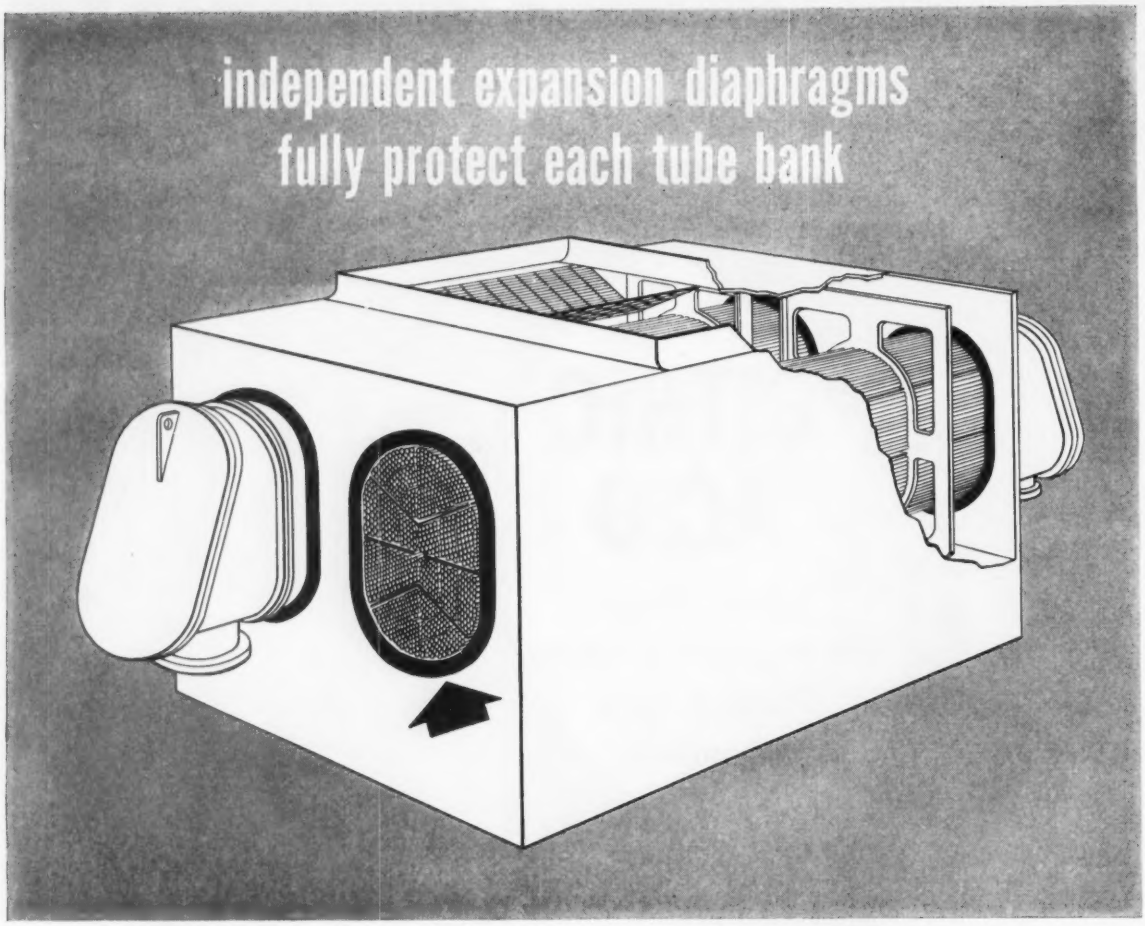

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Technical briefs . . . Latest engineering

Four classic approaches are key to smoke control in load-swing stations

Stack-emission control during power-plant load cycling, *J F McLaughlin Jr and G V Williamson, Union Electric Company*

Smoke emission from generating-station stacks is usually more of a problem during morning load swings than any other time. And this problem is aggravated by the use of old stations for the biggest percentage of the swing. The older the plant the less effective is smoke-abatement equipment (including fuel burners and dust collectors).

Four classic approaches are the keys to controlling emission from these older plants during swings. All four were applied to old plants in our system and results ranged from considerably better to near perfect. But success came only from close cooperation between designers and operators.

The four solutions are: (1) Replacing boiler-combustion equipment, furnaces, dust collectors but retaining other equipment. This step is usually economical only in very old plants charged with special loading. (2) Modernization and modification with minimum new installation, all on a part-by-part basis. Middle-aged plants under fairly heavy loading fit best here—especially if the plant had a flexible layout to begin with. (3) Change of fuel. This could be from coal to oil or gas, or from one type or production of coal to another. (4) New operating methods, techniques and control, an approach often tied to modernization. Getting operators to exert greater care in applying the most recent knowledge of turbine operation can accomplish much.

These approaches were applied to two stations, Ashley Street and Cahokia, with excellent results. New operating methods were applied to all stations used for load swing regardless of age. Although the program to improve stack appearance meant a substantial net expenditure, a glance at the stacks proves that a program like this can be effective for old stations. *ASME 59-SA-28*

Control of nitrogen oxides in boiler flue gases by 2-stage combustion, *D H Barnhart and E K Diehl, The Babcock and Wilcox Co*

High-temperature combustion produces small amounts of nitrogen oxides that react photochemically in the atmosphere to form smog. Oxides come from automobiles, industrial furnaces, boilers. Although steam power plants account for only 15 to 20% of the total nitric oxide produced, decision was made to try to control this source.

Experiments were run both on models and operating equipment. Since most severe smog problem in the U.S. probably exists in Los Angeles tests were run at the El Segundo Station of Southern California Edison Co. Program had three phases: (1) Study operating boilers to determine nitric-oxide quantities in flue gas, effect of burner and furnace design on oxide level and whether changing operating procedures or making minor alterations on burners would reduce oxide level. (2) Perform lab studies to find design and operating variables affecting formation of oxides during combustion. (3) Run field tests to check lab-developed control methods.

Studies so far indicate greatest control over nitrogen-oxide formation is achieved through combustion-air control. Dropping air introduced through the burners to 95% of theoretical air brought about a 27% reduction in oxide production. Using 90% theoretical air cut the oxides by 47%. Full combustion is achieved by introducing the balance of needed air through auxiliary air ports. With minor changes to the burner (approach cones out and air registers wide open) this method has given an overall drop in nitric-oxide production of 56% on one oil-fired boiler at the El Segundo Station, from 525 to 231 ppm. Burning method did not require expensive alterations and is being incorporated in design of new boilers at two other Edison stations. Method has so far proved practical in the field for oil-fired units and in the test lab for gas-fired boilers. No gas-fired boilers were available in the field to confirm lab results on this fuel. *APCA 59-54*

Report of Project SP-4 to Steam Power Panel of the ASME-ASTM Joint Committee on the Effect of Temperature on the Properties of Metals, *J S Worth, Bethlehem Steel Corp*

First meeting of the Project Committee proposed determining short-time high-temperature tensile, creep-rupture and creep properties of SA212 Grade B material. Test specimens were obtained, prepared, tests run and results tabulated. Test data indicate: (1) At 800 F little difference appears in rupture properties between two conditions of heat treatment (as-rolled and stress-relieved; normalized and stress-relieved). (2) At 900 F, the same holds true. (3) At 1000 F there may be a difference but more test work is needed to definitely draw this conclusion. As-rolled may have better properties than normalized, both materials being also stress-relieved. (4) Strength of heavy 3-in.

developments for busy power men

plates is equal to or higher than thinner 1-in. plates.

Results of all three tests are presented in graph and tabular form along with similar tests run on the base metal. *ASME 59-MET-12*

Aluminum condenser tubes, a supplementary report on a plant installation, *W A Pollock, Wisconsin Electric Power Company*

In 1957 the author's company reported to the APC on experience with a 105,000-sq-ft condenser that had operated over a year with 6061-T4 aluminum tubes. Water Technology Committee recommended a supplemental report be given after two years.

Summarized briefly, the 1957 report stated: other than a little steam-side erosion and a few failures from a drain eroding bottom tubes, performance during the first year was satisfactory.

During past two years these favorable experiences have continued. There has been one failure and a few leaks and that's all.

When Unit 4 was installed the company also tried out aluminum tubes in low-pressure extraction heaters. Here the story was different. At first there was much trouble—tubes were being eroded by steam flashing. But modifications stopped this and since then there have been no failures.

Inspection showed aluminum-oxide buildup on steam side of the tubes. Iron-oxide fouling on inside of tubes and heater drain has been higher on this unit than the others. There is an indication that because of fouling, both high- and low-pressure extraction-heater performance on units with aluminum-tubed condensers is poorer than on those with arsenical admiralty tubes. But many alterations make it difficult to be conclusive about this. Despite these troubles, which are not considered major, company has ordered additional aluminum-tubed condensers for new units. *APC 4/1,6-B*

Some recent developments and applications of scrubbers in industrial gas cleaning, *G T Nicklin, Western Precipitation Corp*

After discussing design considerations, author presents operating characteristics and application areas of eight types of commercial scrubbers: washer and spray chamber, centrifugal, venturi, impingement, wet filter, packed tower, film and rotating-element type. He slants his discussion toward scrubbers using water as scrubbing and cooling medium and toward dust and fume removal.

Typical operating problems of corrosion, erosion and wet-dry junctions are discussed. Types of mist eliminators are given along with effluent- or slurry-handling methods. *APCA 59-21*

Directions for ordering these papers on page 110

Corrosion

Development and use of a probe for studying corrosion in superheaters and reheaters, *J G Koopman and E M Marselli, Electric Energy, Inc and J Jonakin and R C Ulmer, Combustion Engineering, Inc*

Joppa Station of Electric Energy, Inc burned Southern-Illinois and West-Kentucky coals and had a superheater-reheater problem. Tube examination showed up to 50% of the metal had been lost. To find how fast metal was leaving the walls samples had to be tested under conditions similar to those in the boiler. It was decided that best way to do this would be with a probe. To avoid difficulties of others in using a probe both a new specimen type and probe were developed.

Specimen is ¼-in. thick, 1-in. wide, machined from a 2-in.-ID tubular section; it bolts to a 2-in.-ID probe by means of lugs welded to the probe. Probe has two sections, one water- and one air-cooled; air-cooled section holds several groups of three or four specimens each. A temperature recorder and air-flow controller and a thermocouple in each specimen complete the picture.

Regulating air flow permits control of specimen temperatures and allows testing at several temperatures during any one run. *APC 4/2, 1-D*

Designing to prevent corrosion in the process industry, *F L Whitney, Monsanto Chemical Co*

Subject of corrosion, fundamental, empirical and practical is a symposium in itself. For this discussion it is assumed the reader has an adequate knowledge of corrosion and factors affecting it. Here, a review is given of methods involved in design to eliminate or mitigate corrosion.

For instance, if your stacks exhaust corrosive gases and liquids to atmosphere, direct any plant expansion to windward side of the stacks (prevailing-wind side). Thus the wind will generally blow away from your buildings. Although very simple, this move can save much maintenance expense. If you are going to build on a peninsula, place plant near shore away from the prevailing wind. Thus much wind-carried salt will drop by the time the breeze reaches you. You can get greater mileage from a paint job by using pipe supports instead of I or H beams to carry pipelines and conduits. Rounded surfaces are easier to cover and premature failures at sharp edges are eliminated.

Galvanizing structural steel, weld construction to reduce corrosion, shell and heater design are all mentioned as author attempts to teach by practical example ways to minimize corrosion through good design. *ASME 59-SA-58*

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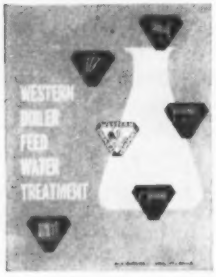

The Chemical Treatment of Boiler Feed Water. This technical bulletin contains a clear explanation of the causes of boiler water problems and Western's methods of solving them. Special emphasis on scale prevention, corrosion control, sludge dispersion, and suppression of foaming and carry-over.

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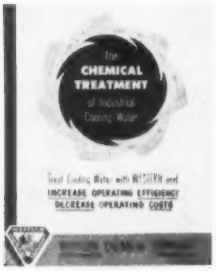
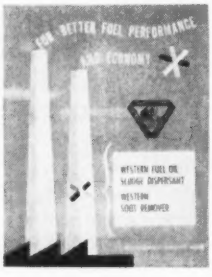


The Chemical Treatment of Industrial Cooling Water discusses common cooling water problems—scale, corrosion, algae, slime. Also presents Western's proven methods for controlling and preventing these conditions in cooling towers, evaporative condensers, process heat exchangers, engine and compressor jackets, chilled water systems, etc.

Better Fuel Performance and Economy discusses the causes and effects of sludge in fuel oil supplies and soot deposits in combustion areas. Shows how these troubles can be eliminated economically, dependably, and permanently with time-tested special Western formulas.



Also, Technical Bulletins on the chemical treatment of potable and plant water supply—refrigerating brine—sweet water systems. Also, the use of Dry Acid Scale Removers.

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Technical briefs

Begins on page 106

Symposium on once-through boiler plants for subcritical pressure, *J G Miller and J S Bartmen, Portland Station, Metropolitan Edison Co*

Portland Station combines (1) subcritical pressure CE-Sulzer monotube steam generator (2) close-coupled cross-compound axial-flow exhaust turbine and side-entry condenser (3) direct-energy-balance combustion control. This paper covers the main design features of the station and early operating experiences of the monotube steam generator.

After completing prestart cleaning, trouble cropped up in the startup procedure. Once-through operation was new to everyone. Also, many of the automatic controls and instruments were either not in service or weren't calibrated. Result was excess manual control and incorrect operation of the automatic components.

Other troubles run into were level indication, deaerator tube collapse and hydraulic Sulzer system ailments. Temperature and pressure sensing devices of the Sulzer system haven't operated with reproducible results. Also, solenoids used to control remote operation of the hydraulic pilot valves will not operate in combination reliably with the pilot valves.

Wall deslaggers and valves distributing flow to individual monotube circuits also gave trouble. Some of these difficulties have been cleared up, some haven't. Details on troubles and solutions are given. *APC paper, no number*

An integrated combustion control system for once-through boilers, *E D Scott, Leeds and Northrup Co*

For the past 30 years it has been conventional practice for the automatic combustion control system to maintain steam pressure by regulating the energy input of fuel and air to the boiler to meet steam demands of the turbine. This operating philosophy was necessary when turbines were supplied by multiple boilers from a common steam header; it has continued as boilers grew in capacity and as boiler-turbine unit operation came into being. Control of this type

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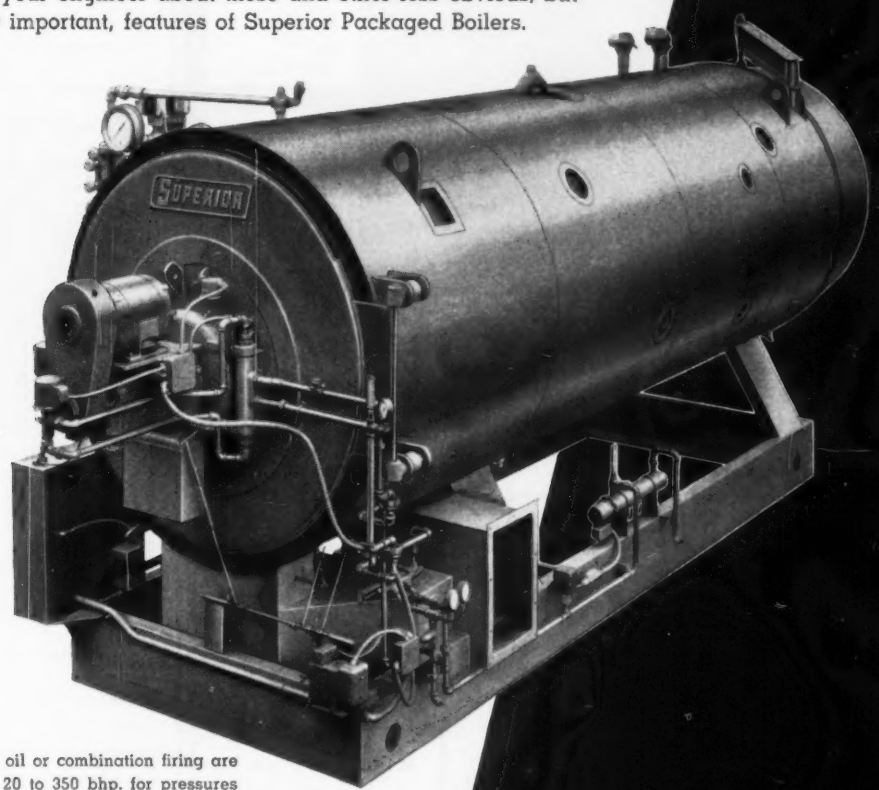

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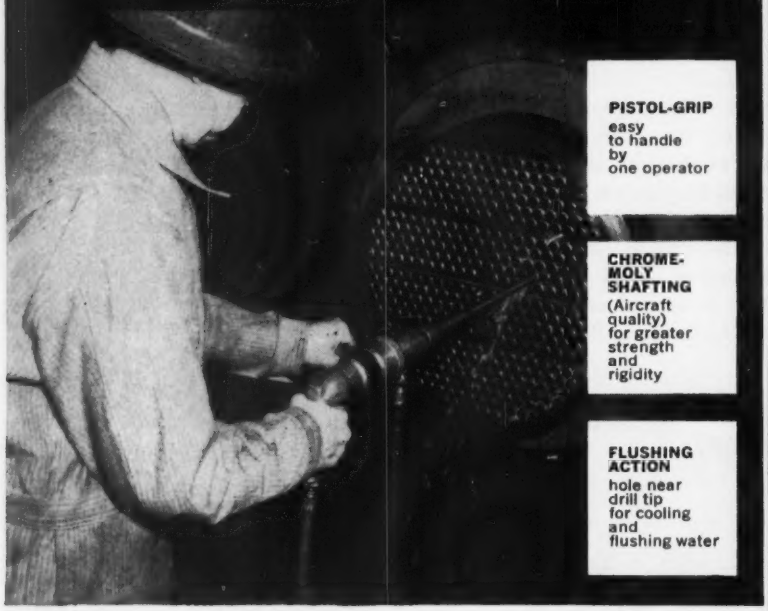
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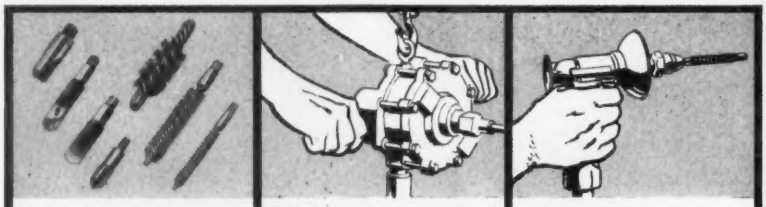

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Technical briefs

Begins on page 106

is satisfactory especially where boilers have relatively large inherent storage capacity and the turbine-generators are normally operated on base load.

A different approach becomes more advantageous as the storage capacity of the unit decreases, as is true with a once-through boiler.

This second method, called the direct-energy balance, regulates inputs of fuel and air to the boiler to give desired electrical output, while steam pressure is maintained by adjusting the turbine governor. This system, with modifications, is described in detail as it has been applied to Unit 4 at Tait Station, Dayton Power and Light Company and Unit 1 at Portland Station, Metropolitan Edison Company. *APC paper 4/1, 1-D*

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American Society of Mechanical Engineers (ASME). Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Power Conference (APC). Papers will be published in book form, obtainable from Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Air Pollution Control Association (APCA). 4400 Fifth Ave, Pittsburgh 13, Pa. Papers are not available at this time.

Fibrous filter medium can solve most aerosol filtering needs, says Mine Safety Appliances Company. Processes of felting, weaving, webbing, wet accretion, flocking, paper making are now under investigation.

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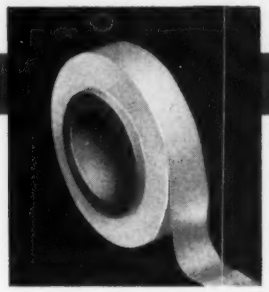

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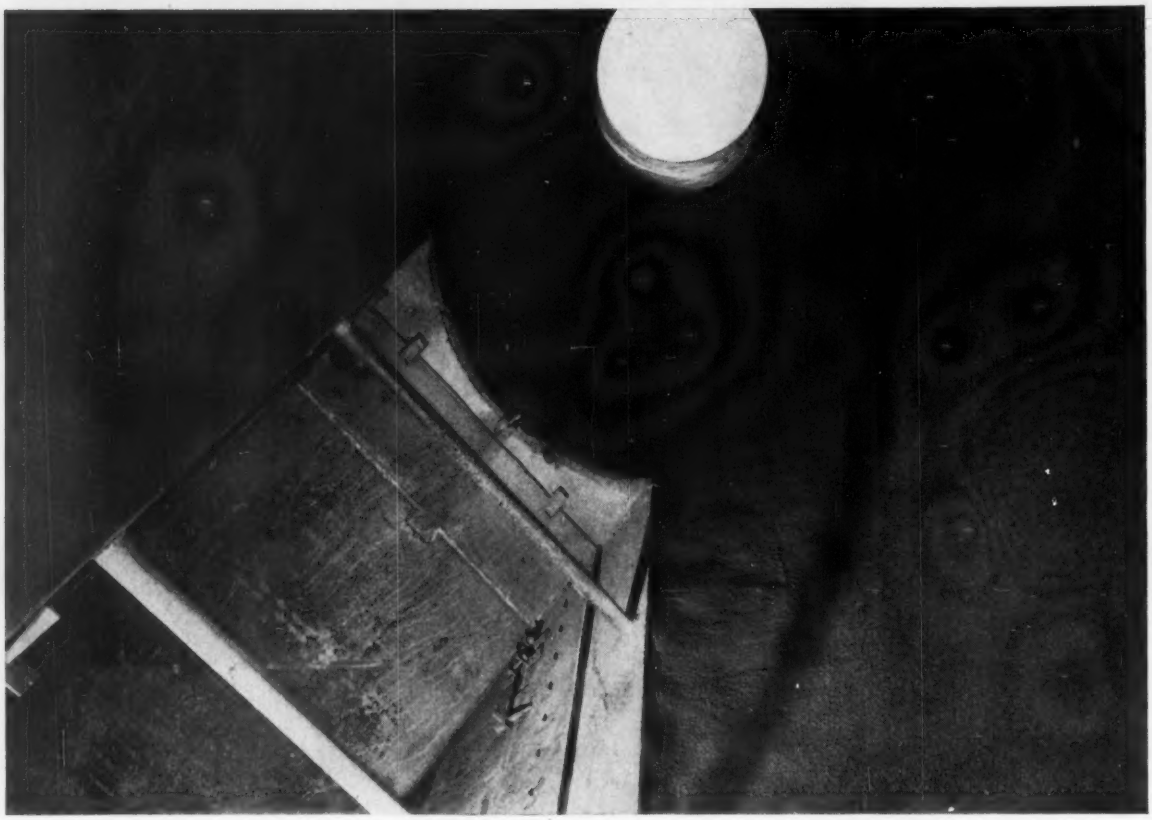

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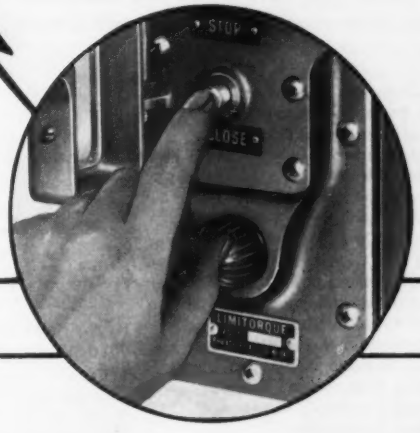

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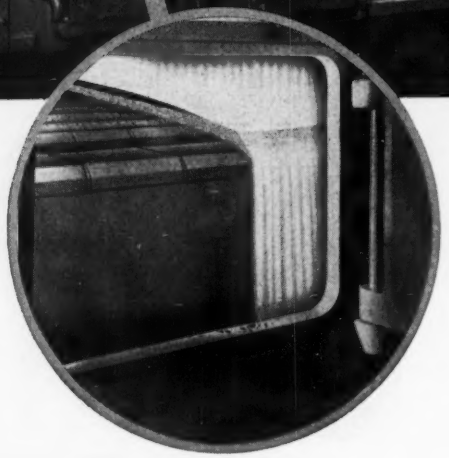

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Pittsburgh Steamship Company
U. S. Dept. of Defense
Wake Forest College

RotoStoker C-C is typical of the Dependable Detroit Line which includes stokers for efficient firing of boilers from 3,000 to 400,000 pounds per hour steam capacity.

DETROIT STOKERS COST LESS: COST EQUALS INITIAL INVESTMENT PLUS UPKEEP PLUS PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

8139

DETROIT STOKER COMPANY
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Hall Industrial Water Report

VOLUME 7 SEPTEMBER 1959 NUMBER 5

Air Conditioning Means Water Conditioning

To the layman air conditioning means air cooling—nothing else. But the engineers who must operate large air-conditioning systems know the part that water plays in the condensers, air washers, humidity control and chilled water systems. They know too, that they need help to prevent the troubles with scale, corrosion and biological growths that occur wherever water is used.

Hall engineers are ready to give the help needed. They are trained to tackle the specific water problems encountered in air-conditioning systems, just as they are trained to assist you in making water in all industrial operations behave . . . from the source, on through boilers, service systems and process to final disposal.

Big Trouble With A Small Unit

When a Pennsylvania university installed a small air-conditioning system, operation was begun without water treatment. The water used was corrosive. After seven months copper condenser tubes in the refrigerating unit were pitted and perforated. So were steel condenser water boxes and baffle and the steel recirculating water receiving tank. Estimated cost of repairs was more than $10,000.

After this bad start Hall engineers were called. R. A. Danesi recommended replacement of the ruined copper condenser tubes with tubes made from a more corrosion resistant copper alloy. He also recommended conditioning of the cooling water with polyphosphate and set up rigid control of pH and blowdown. Two inspections during the next year revealed negligible loss of metal.

In this case, operating personnel were not aware of the necessity for water conditioning. Future trouble will be avoided by carefully following recommendations.

Dispersive Stops Scale

A Los Angeles building frequently had to clean heat exchangers in the air-conditioning system. The water, high in temporary hardness, attained a pH of 8.2 to 8.5 and produced calcium carbonate deposits when concentrated only one and one-half to two times. Treatment with the slowly soluble polyphosphate Micromet® largely eliminated the calcium carbonate but the system became dirty with calcium phosphate.

Hall engineer L. Arnold first considered reducing the pH of the water with sulfuric acid to stop the calcium phosphate precipitation. Building operators wanted to feed acid but the money needed to purchase feeding equipment was unavailable.

Arnold's next suggestion was to supplement the Micromet with some Hagan dispersive for minimizing accumulation of the calcium phosphate. This was done, and during the next air-conditioning season the heat exchangers were not once taken out of service for cleaning. When opened at the end of the season, they were found to be cleaner than they had been in the spring.

The Missing Bromide

Hall engineer G. E. Starr received a rush call for help from a southern hospital. Boiler water chloride tests gave results as high as 1000 ppm compared to a normal 100 ppm, even though the continuous blowdown valves were wide open.

The unusual condition set off a systematic search for the source of contamination. Plant testing was checked and found to be satisfactory. Conductivity tests on boiler water samples showed that the contaminant made up the major portion of the dissolved solids. This led the search to the zeolite softener used to treat makeup water for the boilers. No salt contamination of treated water was found.

The only place left to check was the condensate, which was found to be badly contaminated. A check of all sources of condensate ended at the absorption refrigeration machine where lithium bromide—not chloride—was leaking into the steam coils in the generator. The bromide was showing up in the chloride test.

Immediate repair of the leak not only stopped the contamination of the boiler water, but also the loss of expensive lithium bromide.

Absorption Refrigeration Machines

Absorption systems are very sensitive to scale. Temperature differentials across the condenser are not very great to begin with, and heat transfer falls off markedly as deposits accumulate in the condenser.

Formation of deposits is encouraged by the fact that the controls respond to light loads by reducing the flow of water through the condenser, rather than by cutting back the supply of steam to the generator. Water temperature rises and the formation of deposits is accelerated.

Serious corrosion of tube sheets in condensers and absorbers can occur because of galvanic action between copper tubes and steel tube sheets. Two methods of tackling this problem are to use corrosion resistant alloys for fabrication of tube sheets or to coat tube sheets with protective coatings. In addition, water conditions must be carefully controlled.

All of this points to the importance of water conditioning for uninterrupted operation. Engineers skilled in this work can be of real help to you.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems write, wire or call address below.

Water is your industry's most important raw material. Use it wisely.

HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more facts circle 267 on Reader Service card, p 121

Now's the time to prevent freezing of heater coils... with Production Planned steam trapping

By John W. Ritter, Test Engineer, SARCO Company, Inc.

Freezing of heating coils usually takes place when outside air temperature is slightly below the freezing point, and it is most common in coils that have the steam supply controlled by a temperature regulator which keeps the outlet air temperature constant. Freezing can occur only when the coil becomes water-logged, and in this case the steam trap is often blamed for the trouble.

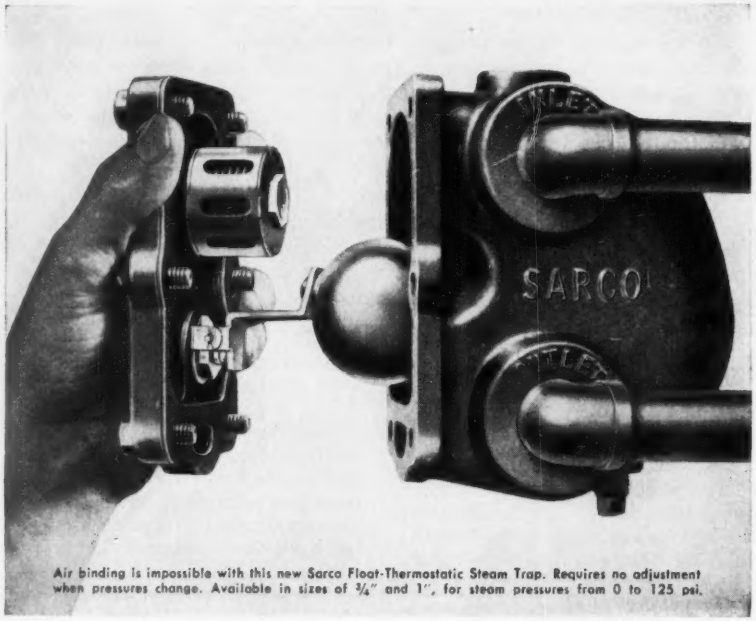
The discharge capacity of any steam trap depends upon the difference in pressure between the trap inlet and its outlet. If there is no pressure difference, the trap cannot remove condensate; and if inlet pressure is lower than outlet pressure, condensate will be held back in the coil.

There are three ways to avoid this difficulty. First, a pressure controlled bypass can be arranged around the temperature control valve to prevent heater pressure from falling below a preset minimum. This plan would make the temperature controller ineffective over part of the range of outside air temperature.

A better solution is to install the steam trap well below the unit, and thus provide a hydraulic leg to enable the trap to discharge even with a vacuum in the steam space. An ample sized vacuum breaker should be installed at the top of the steam inlet of the heater.

To compute the hydraulic head needed, use a figure of 3′ per 1 psi pressure differential. For example, if the trap has the required capacity at 1 psi differential, the minimum head will be 3′.

Thirdly, on new construction, the preheater can be divided into two sections. The first should be capable of raising the air to at least 32° under minimum outside air conditions. The second section should raise the air from 32° to the final temperature. Full steam is supplied to the first coil at all times, while the second is controlled to maintain the final temperature needed. The first coil will not freeze because of the maintained pressure, nor will the second, because minimum air temperature is always above 32°.



Air binding is impossible with this new Sarco Float-Thermostatic Steam Trap. Requires no adjustment when pressures change. Available in sizes of ¾" and 1", for steam pressures from 0 to 125 psi.

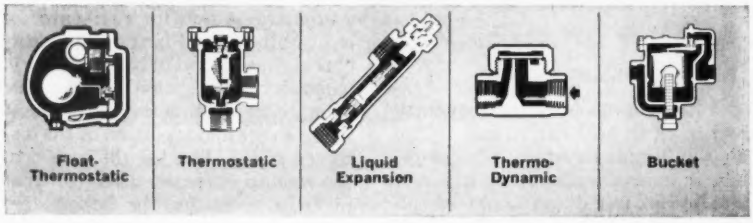
A SARCO F-T Steam Trap will drain condensate completely

Count on the Sarco Float-Thermostatic Steam Trap to discharge condensate practically at steam temperature, continuously and without shock. Sarco F-T's do not cause pressure fluctuation while discharging.

For *production planned* trapping of heating coils, with accurate temperature control, use the new Sarco Steam Trap Type F-T.

Write for Technical Bulletin T502 on prevention of freezing in heater coils. You'll also receive a bulletin on Sarco F-T Steam Traps.

Remember that Sarco can give you *impartial* advice on steam trapping because only Sarco makes all 5 types. 5968-B

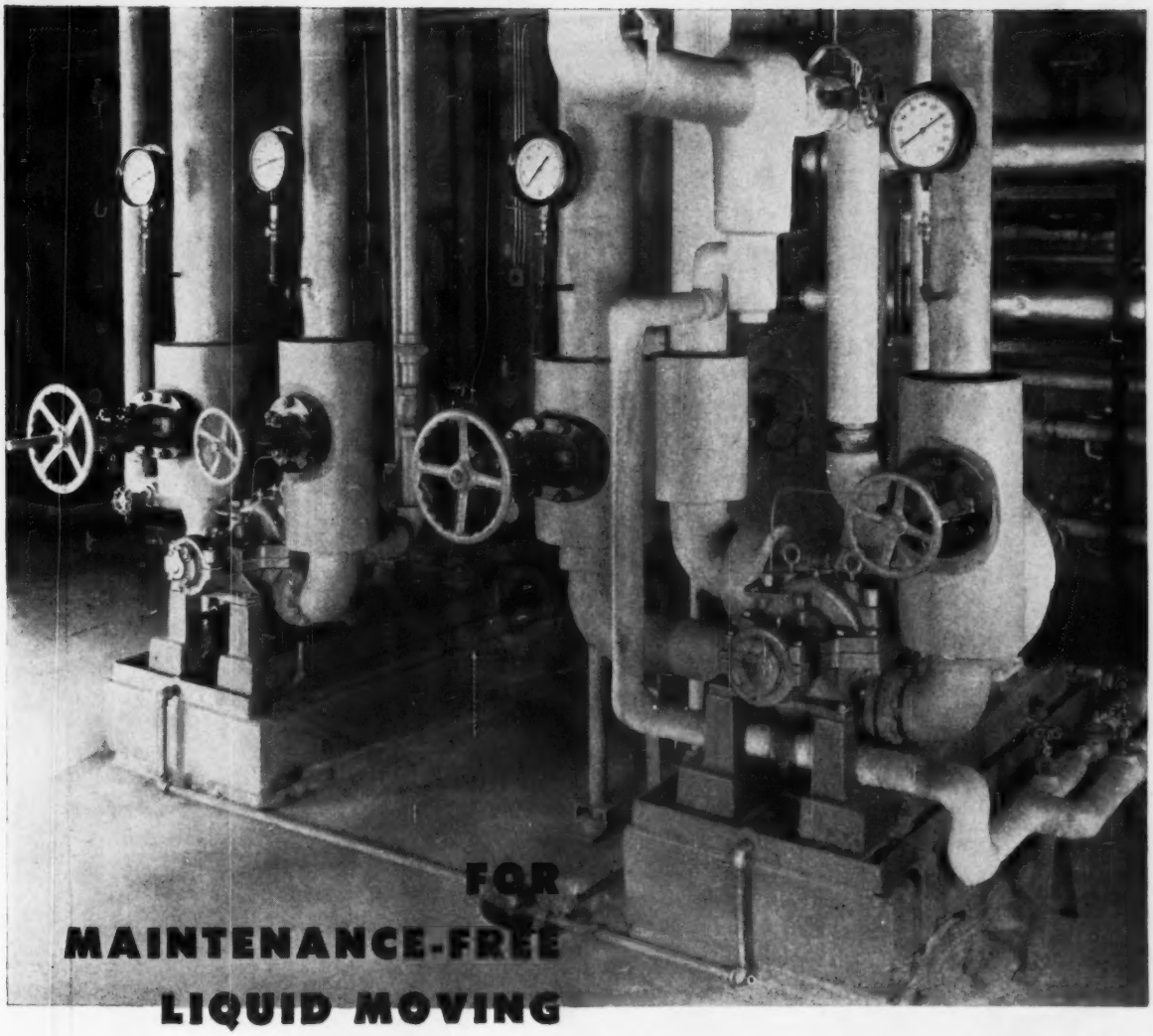


SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

Only Sarco makes all 5 types:
Thermostatic • Liquid Expansion • Float Thermostatic
Thermo-Dynamic • Bucket

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

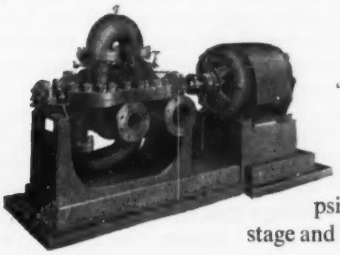
For more facts circle 268 on Reader Service card, p 121



FOR MAINTENANCE-FREE LIQUID MOVING

"Buffalo" Class "RR" Pumps

For boiler feed and other high pressure, high temperature applications with clear water, "RR" Pumps deliver the utmost performance with an absolute minimum of maintenance. The unique "Buffalo" Class "RR" design is unsurpassed for consistent hydraulic balance. Rugged "Buffalo" construction features include efficient impellers — extra generous bearings and shafts — rigid casings with simply-formed passages to avoid friction losses — very deep stuffing boxes to accommodate more packing.



"Buffalo" Type "RR" Boiler Feed Pumps for pressures up to 500 psi. Available in two-stage and four-stage models.

These superior "Buffalo" design and construction features assure you of pumps that will stand up under continuous punishing service — that require practically no attention other than lubrication — that deliver more water at less cost for power.

The "Buffalo" Class "RR" Pump is your best buy for clear water service — hot or cold — against heads as high as 1500 feet — at capacities up to 900 gpm. Ask your nearby "Buffalo" engineering representative for full information, or write us for Bulletin 980-D.

"Buffalo" Pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO PUMPS

Division of Buffalo Forge Co.

"Buffalo" PUMPS

488 Broadway • Buffalo, N. Y.

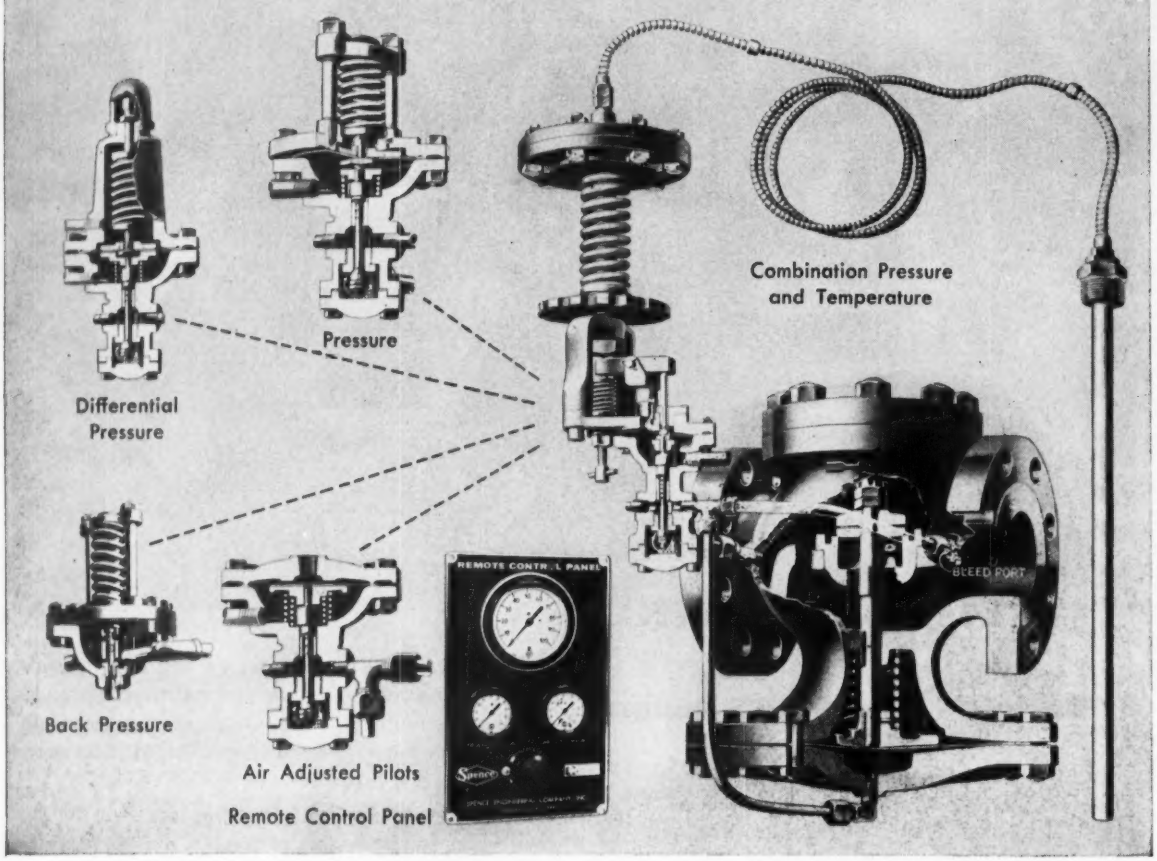
Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

For more facts circle 269 on Reader Service card, p 121

All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

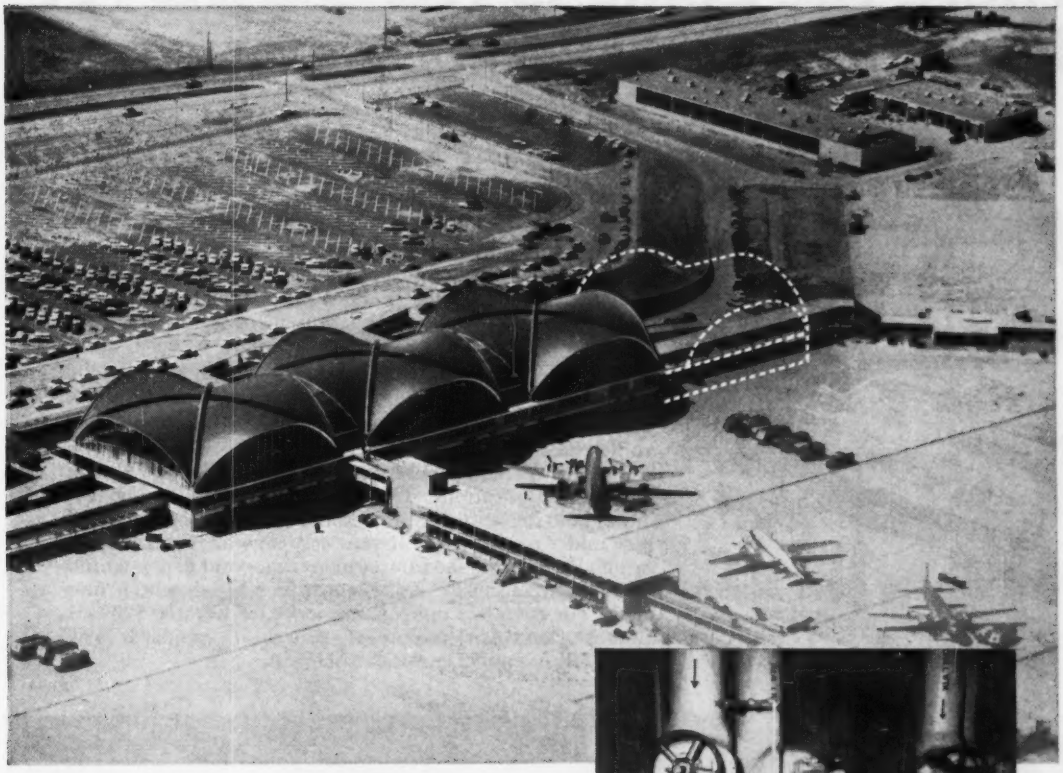
If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

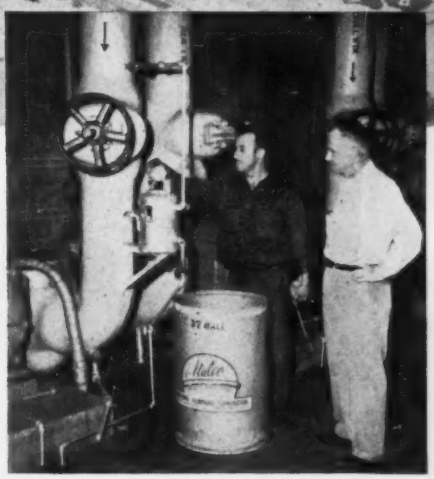
All Spence pilots fit all sizes of Spence main valves. If you have twenty pressure regulators, for instance, all you need is *one spare pilot*. It will fit all main valve sizes from ¼" to 12".

Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York SE-148





Nalco protects vital services of new

LAMBERT-ST. LOUIS AIRPORT

Functional efficiency is usually one of the hallmarks of fine architecture and it is apparent throughout the new St. Louis Municipal Airport Terminal Buildings.

Vital service facilities are housed in a low, clean-lined power plant, well separated from the present main terminal building in anticipation of planned expansion to accommodate increasing airline traffic. The Nalco System protects boiler and cooling water systems by effectively controlling scale, corrosion and microbiological growth . . . a non-architectural supplement to functional efficiency in *any* plant where water is used.

Whether you are planning a new plant, or modernizing an old one, call on Nalco for water treatment chemicals and services that consistently produce outstanding results.

Top photo: Unusual modern architecture of St. Louis Municipal Airport Terminal Building is expandable in any direction. New units (dotted lines), can be added readily when required. Services buildings, *upper right*, are built and equipped with future expansion in mind. *Photo by Lloyd Spainhower.*

Lower photo: Nalco Chemicals and Services protect both boiler and cooling water systems at new St. Louis Airport. In this photo a Nalco cooling water treatment, supplied in ball briquette form, is being applied through the convenient Nalco feeder.

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NALCO CHEMICAL COMPANY

6227 West 66th Place • Chicago 38, Illinois

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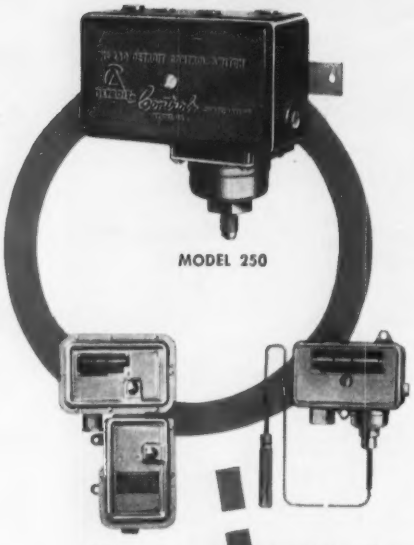
THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Nalco CHEMICALS

For more facts circle 271 on Reader Service card, p 121

Where the going is RUGGED...

ALWAYS SPECIFY DETROIT CONTROLS



For more than 30 years—on land and at sea—Series 250, 223 and 220 controls manufactured by Detroit Controls have set both quality and performance standards for control mechanisms activated by either temperature or pressure variations.

These precision-built controls operate within temperature ranges of −60°F through 600°F and pressure ranges of 30 inches of vacuum to 6,000 pounds. They are designed to meet the HI-2000 foot pound shock requirements of the Bureau of Ships and "Service A" of Navy Department specifications MIL-C-2212, MIL-C-2174 and MIL-S-901. They are available in both splash-proof and watertight models.

Because of their exceptional accuracy and complete dependability these Detroit controls are widely used—both ashore and afloat—on motive power and in refrigeration and air conditioning applications. They are, for example, being used throughout the atom-powered commercial ship N. S. Savannah now under construction. If your company has control applications demanding the utmost in accuracy and dependability specify Detroit 250, 223 or 220 controls. There are none finer made. For complete information write for Catalog 100-GM. Detroit Controls Division of American Standard, 5900 Trumbull Avenue, Detroit 8, Michigan.

(OFFICIAL U.S. NAVY PHOTO)

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AMERICAN-Standard

DETROIT CONTROLS DIVISION

DETROIT CONTROLS DIVISION—Ad No. 59-114—Marine Engineering Log, August and November 1959 • Power, September 1959

For more facts circle 272 on Reader Service card, p 121

Your service center for FREE data

Either of the no-postage Reader Service cards below and p 123 will bring you information on any new equipment listed or product advertised, plus new literature for your files

- **Study New Equipment** described in this issue starting on p 140. Circle numbers on card corresponding to items listed
- **Check New Literature** available this month beginning on p 122. To get your personal copies use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
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New free literature

AIR CONDITIONING, HEATING AND VENTILATION

101 **Packaged air conditioners** are topic of 8-p brochure 8525. Descriptions, illustrations of design and construction features, table of capacities and physical data covering both air-cooled and water-cooled designs are included. American-Standard, Industrial Div

102 **Cabinet unit heaters** are described and illustrated in 8-p bulletin 351. Charts and tables for steam and hot water ratings are included. McQuay, Inc

103 **Gas-fired duct heaters,** encased and open blower assemblies are featured in bulletin GD-100. Specifications, ratings, performance and physical data are also given. L J Wing Manufacturing Co

104 **Air-cleaning requirements** are discussed and illustrated in 16-p brochure 234-PL. Bulletin discusses electric motors, air conditioning and their roles in providing clean air, filter locations, maintenance and ventilation situations. American Air Filter Company, Inc

105 **Centrifugal dust collector** is presented in 8-p bulletin 291A. Cutaway diagrams, schematic drawings and a revised dimensions chart are included. American Air Filter Company, Inc

106 **Cloth-filter dust collectors** are discussed in information sheets. Torit Manufacturing Company

107 **Ventilation, air conditioning,** collection or exhaust systems are covered in 12-p catalog 35-8. Carrier Corporation

METALS AND MATERIALS

108 **Nonwoven synthetic material** which can be used for filtration, insulation, abrasion resistance is introduced in 8-p illustrated brochure. Troy Blanket Mills

109 **Stainless steel,** sulfuric-acid-resistant type, is described in 4-p folder. Union Steel Corp

COMPRESSORS AND ACCESSORIES

110 **Condenser - filter - separator** with internal traps is featured in 4-p product bulletin 4518. Descriptions, specs and cross sections are given. Hankison Corporation

111 **Field compressor,** 2-cycle heavy-duty unit, is presented in bulletin 171. Includes illustrations and descriptions of running gear. Clark Bros Company

112 **Electromagnetic pulleys** are introduced, operating principles explained in 8-p bulletin 1011. Includes tabulation of approximate weights per cu ft of 146 materials often handled on belt conveyors. Stearns Magnetic Products

ELECTRICAL DISTRIBUTION AND PROTECTION

113 **Integrated substations** are diagramed showing various arrangements in 8-p bulletin. Moloney Electric Company

114 **Wiring system standards** are discussed in 4-p bulletin RCT-102. Sections on automation, conduit systems, wiring methods, an illustrative table and a recent bibliography are included. Rome Cable Corp

115 **Motor control centers** are featured in 12-p bulletin UM-100 which gives specs, dimensions and layout guidance information. Electric Distribution Products Inc

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116 **Primary unit substations** are topic of a 4-p bulletin 2701-1A. I-T-E Circuit Breaker Company

117 **Dc failures** in cable insulation are discussed in a 4-p bulletin RCT 712. Rome Cable Corp

118 **Circuit breakers** are featured in 8-p selection bulletin S-4261-2B. Sections on visible break, closed-cover drawout, breaker inspection, adjustment, removal and trip setting are included along with application and enclosure dimensions, charts, coil types and ratings. I-T-E Circuit Breaker Co

119 **Fuses** for protecting transformers are described in 4-p bulletin 281: This gives ratings and dimensions and explains universal application. S&C Electric Co

ELECTRICAL APPLICATION

120 **Limit switches** are discussed in 10-p booklet which offers suggestions for their application. Minneapolis-Honeywell Regulator Company, Micro Switch Div

121 **Storage batteries** are featured in 86-p handbook GB-1896. All phases of battery theory, operation and maintenance are covered. Line drawings and a table of ratios of water to acid required to obtain given specific gravities when preparing electrolyte for repairs are included. Gould-National Batteries, Inc

122 **Meter buyers' guide,** bulletin GEC-1400, is a 64-p booklet which provides information on firm's line of single-phase and polyphase watthour meters, watthour demand meters, meter sockets and water-heater time switches. Included also is a quick-reference guide to standard meter applications. General Electric Company

INSTRUMENTATION

123 **Computer system** is covered in 14-p booklet which outlines speeds, capacities and overall performance qualifications of all-transistorized electronic system. Minneapolis-Honeywell Regulator Company, Datamatic Div

124 **Electronic digital-computer** system, installations and applications in the petrochemical industry are discussed. Burroughs Corp, Electro Data Div

125 **Signaling controller** is described, specs listed in 4-p catalog. Thermo Electric Company

126 **Selector station** is topic of 4-p product specification sheet P99-1. Bailey Meter Company

127 **Electronic static controls** are featured in a 20-p illustrated booklet which discusses concepts of surface impedance controls and describes principles of operation and operating characteristics. Ovitron Corp

128 **Control valves,** transmitters, drainers and relays have specifications listed in 6-p bulletin 709. Black, Sivalls & Bryson, Inc

129 **Common mode voltage** and errors that signals can introduce into measuring instruments are discussed in 4-p reprint. Cohu Electronics, Inc, Kin Tel Div

130 **Combustion-control system** for cyclone furnaces is diagramed and drawn schematically in 4-p bulletin 514. Bailey Meter Co

131 **Pressure control** 3½ by 4 in. which weighs 1¾ lb is featured in bulletin 02. Mercoid Corporation

continued

September 1959 issue

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NEW FREE LITERATURE continued ..... Circle key numbers, page 121, for your copies

132 **Control systems** for automatic operation and protection of gas-engine compressors are topic of 4-p bulletin. Ingersoll Rand

133 **Indicators** and indicating controllers are discussed and illustrated in 4-p bulletin 65. Thermo Electric Company

134 **Pointer, indicator gages** are featured in a series of product specification sheets. Hays Corp

135 **Vibration indicator, transistorized** unit, is announced in 4-p bulletin. Vibration Engineering service

136 **Speed changer kit** is introduced in new bulletin. Metron Instrument Company

137 **Vibration switch** for low-gravity applications is topic of data sheets. Operating data, sensitivity, electrical data, calibration and service life are sections included. Inertia Switch, Inc

138 **Video switching** and distribution system is introduced in bulletin 6-99. Detailed specifications, installation information are included. Cohu Electronics, Kin Tel Div

139 **Universal portable tester** is featured in 8-p bulletin SB-OCR-1. Electrical test objectives, operation and advantages are some topics discussed. Multi-Amp Electrical Corp, Multi-Amp Div

140 **Thermistor probes** for use in remote reading telethermometers and controllers or as component transducers in special instrumentation are discussed in 6-p bulletin. Yellow Springs Instrument Company

141 **Dial measuring instruments** are illustrated in bulletin 451A. Price list and table of ranges is included. Testing Machines, Inc

142 **Rotameters** for measurement and control of small fluid flows are introduced in 4-p bulletin 18P. Sectional drawings, dimensional and capacity data and diagrams are included. Schutte and Koerting Company, Instrument Div

143 **Electronic measuring** and data-handling systems are outlined in bulletin G-101. Gilmore Industries, Inc

144 **Gamma alarm** and air monitor for detecting radioactivity are described in new publication. Nuclear Measurements Corporation

145 **Multiple pressure** readout system is described and illustrated in 12-p bulletin 30B1000. Tables of differential and absolute ranges are given. Fischer & Porter Company

146 **Aluminum-case meters** are detailed with description of operations, construction and specs in bulletin 305. American Meter Company

147 **Running-time meters** (elapsed time meters) are featured in bulletin 810. Detailed specifications and mounting dimensions are included. Herman H Sticht Company, Inc

148 **Weighing system,** 5000-lb capacity weighing cells is topic of 8-p brochure 591. A H Emery Co

149 **Temperature transmitter,** helium gas-filled system, is discussed in 4-p product specification sheet P51-4. Operating characteristics and installation requirements, standard ranges and accessories are listed. Bailey Meter Co

continued

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The **NEW** Model AA AMESTEAM GENERATOR offers the ultimate in steam generating efficiency and reliability.

The **NEW**ly designed low pressure air atomizing oil burner will cleanly and uniformly burn all commercial grades of oil — #4 with little or no preheat — for more efficient, economical firing. Since electric pumping and preheat loads are lower, power costs are greatly reduced. For gas firing the **NEW** ring type burner provides a more uniform flame pattern for cleaner, more efficient combustion.

All Model AA AMESTEAM GENERATORS are designed to operate at top efficiency over a modulation range of 20% to 100% of rating.

The Model AA incorporates Ames' time-proven 3-pass concentric tube design, single one-piece baffle and one-piece flue covers. Easier access is provided for inspection and servicing. The **NEW** ultra-compact design simplifies positioning and installation. All units are factory-assembled and fire-tested.

Before you buy a package boiler get the facts on the all **NEW** Model AA AMESTEAM GENERATOR.

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AMES IRON WORKS, INC., Box H-81, Oswego, N. Y.

Please send me full details on the **NEW** AMESTEAM GENERATOR Model AA Package Boiler.

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For more facts circle 273 on Reader Service card, p 121

"GOOD FROM THE FIRST DROP"

..Steam Traps ready to go again with a B-J Cage Unit

The moment you drop a B-J cage unit replacement into a faulty steam trap — it's good again . . . renewed and ready to go to work. Now there's no reason for prolonged shut-down while you repair imperfect traps. You simply:

- **REMOVE** the cap right on the line
- **REPLACE** the interior with a B-J cage unit
- **RECAP** the trap assembly
- **RENEWED** . . . all new and ready to go

It's as easy as replacing a light bulb and the cage unit element is always where it belongs for rapid response to trap conditions. For in this modern unit, a quick-action, completely accurate bellows is combined with a perfect-fit plug and seat, then enclosed in a sealed monel cage. And there may be no need to dispense with your present steam trap investment. B-J industrial cage units can probably be installed in your present thermostatic traps or used in a complete B-J system.

For the complete story on steam trap functions and maintenance — write today for "The Steam Trap Primer". You'll see the 'hows' and 'whys' of steam trap performances. And perhaps you'll see how B-J cage units can end your steam trap problems.

"Be Wise . . . Be Sure . . . B-J"

BARNES & JONES, INC.
36 Crafts St. • Newtonville 60, Massachusetts

Free literature

Begins on page 122

150 **Pressure-indicating** transmitter, precision model, is described in 4-p spec sheet 11-1221-2. Fischer & Porter Company

151 **Flame-failure bulletin** 523 discusses elimination of explosions and application of safety unit to oil, coal or gas installations. Descriptions and drawings of principle of operation are included. Photomation, Inc

WELDING

152 **Welding-carbon** product manual is a detailed description of use of carbon plate, rod and paste to speed up welded repairs. Arcair Electric Company

153 **Welding machines** are topic of illustrated bulletin 4608.1. Operating features, construction details and applications are listed. Lincoln Electric Company

154 **Arc-welding data card** indicates proper types of electrodes to be used and provides information on suggested preheat and postheat treatments. Babcock & Wilcox Company, Tubular Products Div

155 **Welding of austenitic** and ferritic stainless steel is discussed in folder TDC 162. Babcock & Wilcox Company, Tubular Products Div

156 **Carbon-dioxide welding** of mild steel and low-alloy steels is illustrated and described in a 24-p booklet. Fundamentals of the process are included, plus descriptions of outstanding characteristics. Manual welding guns and automatic welding heads, wire feeders, controls are covered. Air Reduction Sales Company, Inc

157 **Machine cutting torches,** tips and accessories are discussed in 12-p catalog. Air Reduction Sales Company, Inc

MAINTENANCE

158 **Waste-disposal system** is topic of a 12-p brochure which gives step by step photo-diagram of every stage of operation. Cutting of industrial waste-disposal costs is central theme. Wandel Machine Company, Inc

159 **Diesel-engine care** is discussed in illustrated series of bulletins. Cummins Engine Company, Inc

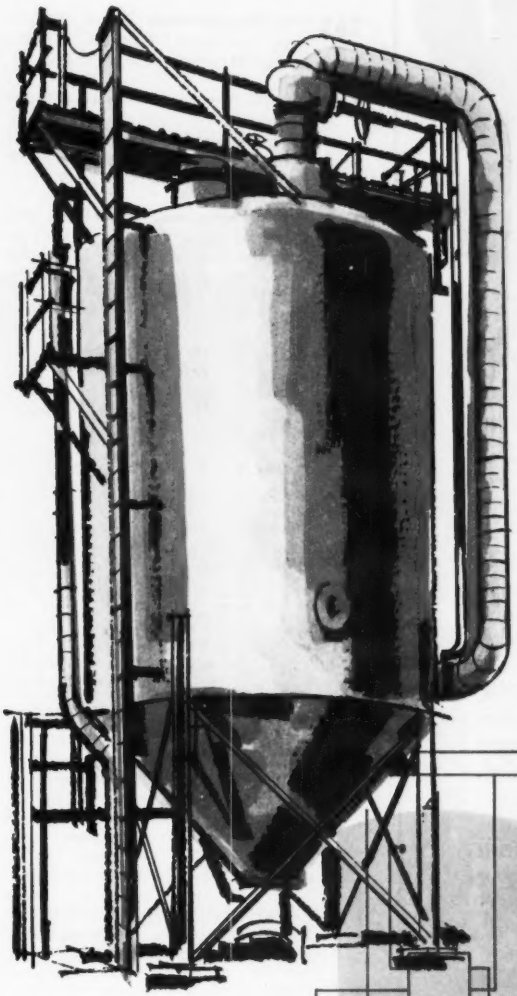
160 **Protective coating** for floors, walls and machinery which is especially resistant to abrasion chemicals and solvents is described in 4-p brochure. The Garland Company

NUCLEAR ENERGY

161 **Nuclear-applications** worksheet is used to determine whether radioactivity can aid in solving

Progress in water conditioning . . .

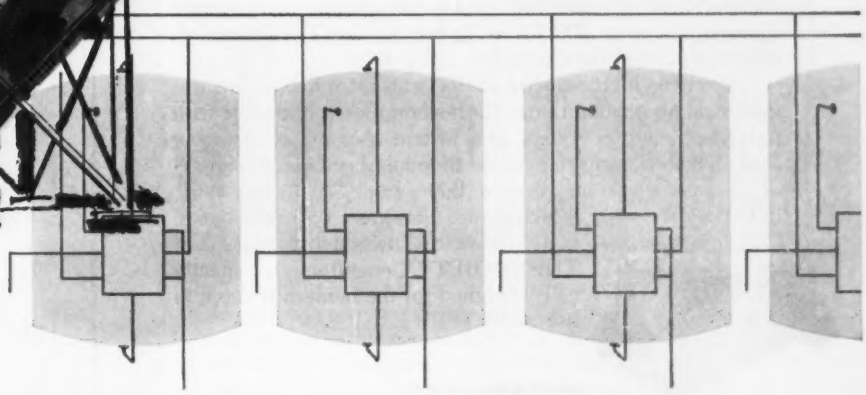
A Hot Process System can provide the higher quality water you need



Modernization of your plant may call for higher quality water than your present hot lime soda installation can supply. If so, the answer may be conversion to a Cochrane Hot Lime-Zeolite System, with relatively low additional capital expense, a reduction in operating cost and the advantage of silica reduction as well as complete hardness removal.

The addition of hot zeolite softening to your existing hot process plant permits the use of the present installation. The chemical operating cost for such an installation have been consistently under other treatment methods, and the quality of the treated water is superb.

Cochrane will be glad to assist you or your consulting engineers in evaluating the advantages of Hot Lime Zeolite for your plant. Write: Water Treatment Division.



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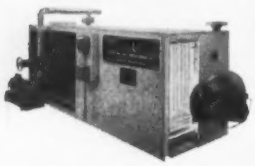
No matter what your requirements . . . 180° F. . . . 220° F. . . . 250° F. . . . 300° F. . . . 350° F. . . . 430° F., International-LaMont THERMOJET® Hot Water Generators are your key to truly significant savings in modern hot water heating systems.

HIGHER TEMPERATURE DROPS MEAN GREATER ECONOMY

These forced recirculation water tube Generators extract *more* heat from *less* water. By merely increasing the temperature differential between boiler outlet and return water from the "conventional" 20°F. to 80°F., water flow rates are cut 75%. Lower flow rates mean reduced pipe and pump sizes, with attendant savings throughout the system. With International-LaMont THERMOJET® Generators, temperature differentials up to 200°F. are in use and are recommended, effecting even greater savings.

Positive, high velocity boiler water circulation assures peak heat absorption rates—far beyond those obtainable with natural circulation boilers, plus instant response to changing load demands. Any danger of thermal shock is eliminated.

Set your own temperature limits from 180°F. to 430°F., but project your thinking in terms of the unmatched capabilities of International-LaMont THERMOJET® Generators . . . specifically designed for the modern concept in hot water heating.



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Free literature

Begins on page 122

production, processing and quality-control problems. Nuclear Science and Engineering Corp

162 **Fuel-element manufacture** is topic of bulletin NCB-1. This deals specifically with fuel for nuclear reactors. Babcock & Wilcox Company, Boiler Div

MECHANICAL POWER TRANSMISSION

163 **Coupling-selection** guide is feature of 12-p bulletin A669B. Dodge Manufacturing Company

164 **Double-row ball bearings** are described in 4-p bulletin 111. Tables of dimensional data and radial load ratings are included. Hoover Ball and Bearing Company

165 **Deep-groove ball bearings** are featured in a 12-p bulletin 110. Information is given on types and sizes, radial load and other application data. Hoover Ball and Bearing Company

166 **Dry bushings, thrust washers** are topics of bulletin DU-458A. Dimensions and instructions for fitting thrust washers are included. United States Gasket Co

167 **Roller bearings** are featured in a 48-p engineering reference manual M-59. Construction, dimensions, capacities, housing and tolerance fits are listed. Orange Roller Bearing Company

168 **Worm-gear sets** are detailed in illustrated 24-p catalog which provides drawings, selection data and basic information on worm gearing. De Laval Steam Turbine Company

169 **Gearmotors** are discussed in 2-p booklet J-17. Information on horizontal- and vertical-mounted gearmotors with capacity up to 125 hp and output speeds ranging from 780 to 1.2 rpm, load characteristics and selection tables are included. Hewitt Robbins, Inc

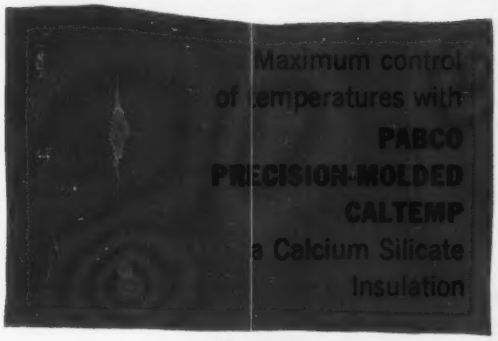
170 **Variable-speed drive** bulletin 195 has 8 pp, features photographs of drives and modifications, suggested variable-speed applications, info on hp, type of duty, speed variation. Sterling Electric Motors, Inc

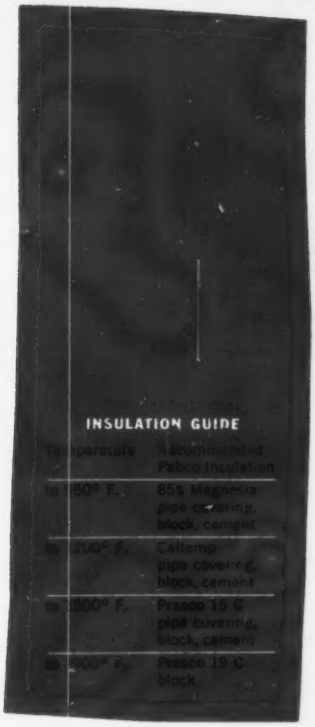
171 **Speed and drive control** problems are discussed in 8-p bulletin K-250. Typical applications of remote and automatic control are detailed. Cleveland Worm & Gear Company, Speed Variator Div

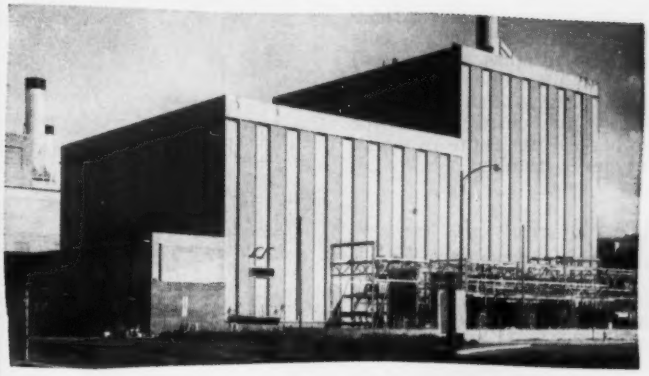
172 **Speed drives,** mechanical and adjustable 25-hp units, are introduced in 16-p illustrated bulletin GEA-6806. Principle of operation and features are discussed, mounting positions, rating tables and descriptions of available accessories included. General Electric Company

continued

For more facts circle 276 on Reader Service card, p 121







Curb expensive heat loss, control temperatures within minimum tolerances with performance-proved Pabco Insulations.
For power plant piping and equipment, a Pabco Insulation insures peak performance wherever temperatures must be maintained up to 1900° F. Pabco's Caltemp and 85% Magnesia insulations are "Precision-Molded" by a patented process in both pipe and block form.
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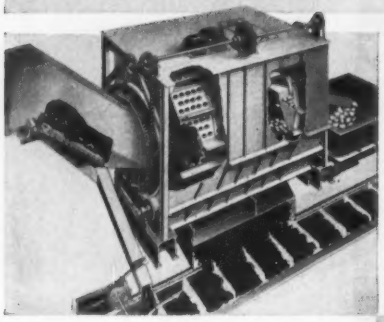
More and more utilities now use this

Rugged Cost Cutting Coal Processing Equipment

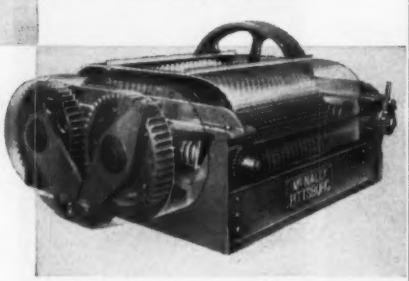


McNally Pittsburg Rotary Breaker

This heavy-duty unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is usually drastically reduced.

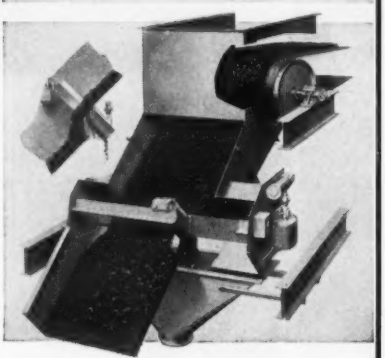
Gearmatic Stoker Coal Crusher

Built to handle heavy coal tonnages, these crushers have proved most efficient to reduce 8″ minus to stoker grades. They offer three major advantages: 1) high volume production; 2) accurate sizing; 3) low percentage of fines.



McNally Pittsburg Primary Coal Sampler

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges into chute in which sampler is installed.



Ask the men who know coal from the ground up!

Your McNally Pittsburg man offers more than 37 years of experience in the preparation of coal. He can save *you* time and money in the selection of equipment to do your job more efficiently. *Write today!*

McNALLY PITTSBURG

MANUFACTURERS OF EQUIPMENT TO MAKE COAL A BETTER FUEL

McNally Pittsburg Mfg. Corp.
Dept. P, Pittsburg, Kansas
Gentlemen: Send me more information on these products:
☐ Rotary Breaker ☐ Coal Crusher ☐ Primary Coal Sampler

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Free literature

Begins on page 122

173 **Roll gear drive** indexing mechanisms are featured in 24-p catalog 108. Speeds, info on calculating load requirements, load ratings and dimensions are included. Ferguson Machine Corp

PUMPS

174 **Rubber impellers** for self-priming pumps are described in illustrated catalog sheet. Pacific Moulded Products Company

175 **Hydraulic pump** with dual volume, dual pressure is announced in bulletin V-1. Unit delivers from 600 cu in. of oil per min at 100 psi to 50 cu in. of oil per min at 10,000 psi. Owatonna Tool Company, Precision Hydraulic Div

176 **Rotary pumps** are featured in 12-p bulletin 278 which lists performance and installation data and includes a buyers' guide. Roper Hydraulics, Inc

SAFETY

177 **Inhalation therapy** is discussed in a 12-p booklet NM-116 which describes equipment and techniques for use during stoppage of breathing. Prepared especially for plant physicians, industrial safety directors and personnel management. Chemetron Corp, National Cylinder Gas Div

178 **Fire-fighting equipment** is described and illustrated in 16-p brochure. Chart of types of extinguishers used for different fires is included. Walter Kidde & Company, Inc

STEAM GENERATION

179 **Underfeed stoker applications** guide Gs-1 is a 58-p revised and expanded edition concerning stoker applications to boilers. Includes drawings of layouts, specs. Bituminous Coal Institute

180 **Conversion** of high-pressure hot-water generating plant for production of both steam and hot water is topic of 4-p reprint. Schematic drawings, photographs included. Midland-Ross Corp, J O Ross Engineering Div

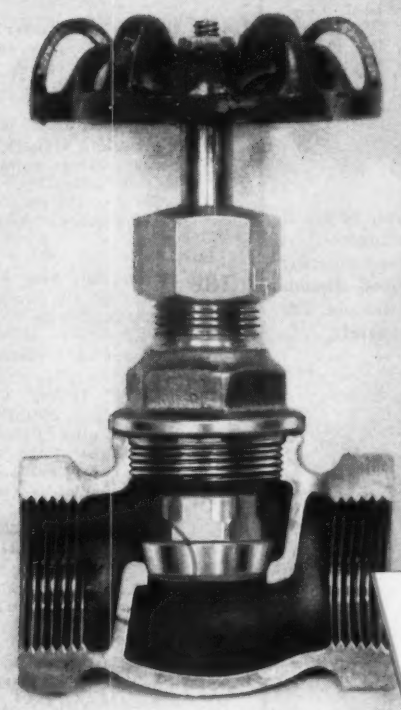
181 **Underfeed stoker** with double retort feature built for boilers of about 20,000 to 34,000 lb of steam is topic of 8-p catalog 401. Detroit Stoker Company

182 **Flyash removal** is featured in 4-p technical report Er-49-2. Fuller Company

183 **Miniature gas-turbine** engine is described in illustrated catalog sheet. Twin-spool coaxial ma-

O-B VALVES

metal-to-metal contact stops oil seepage

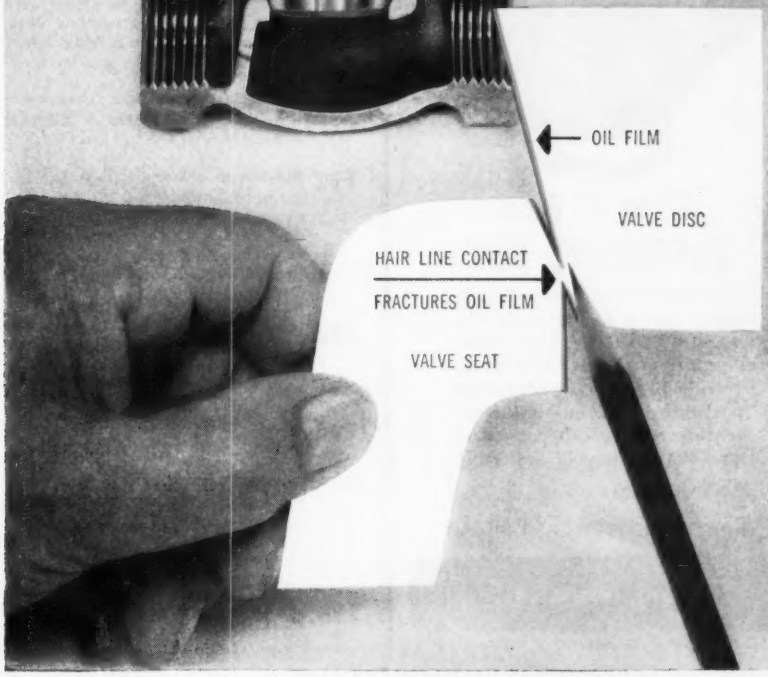


The lubricating properties of oil, ideal for preventing friction between moving parts, makes it almost impossible to get a tight shutoff on oil lines with an ordinary valve.

Oil forms a thin film over the seating surfaces of a valve. If not fractured when the valve is closed, a pathway remains for oil to seep through, past the disc and seat.

O-B No. 101 bronze globe valve (and its companion No. 102 angle valve) was designed for service with oil and other hard-to-handle fluids. Disc and seat are machined to make a hairline, metal-to-metal contact which shears neatly through oil film, giving a tight, leakproof seat.

Ask your O-B distributor about these valves, or write: Ohio Brass Company, Mansfield, O.



HOLAN

4994-V

For more facts circle 279 on Reader Service card, p 121

With these 3 RIDGID® Jam-Proof Pipe Threaders my power drive threading is Safe—no watching to keep them from jamming...save me a lot of time, too!

1" to 2" Pipe RIDGID 65R-TC

Jam-proof—can't jam if you forget it . . . Threads 4 sizes of pipe and conduit with 1 set of dies . . . True-Centering workholder—no more crooked threads—but adjustable for drip threads. Far more for your money—compare!

2½" to 4" Pipe RIDGID 4PJ

Jam-proof . . . drive pinion kicks out automatically—real safety when power threading. Workholder sets to size before putting on pipe. Other exclusive advantages. Special 4PJ for conduit.

4" to 6" Pipe RIDGID 161

Jam-proof for safe power threading. 1 set of dies threads 4", 4½", 5" and 6" pipe and conduit—sets to size fast. Workholder sets to size before putting on pipe, a work-saver feature. Many other reasons why the 161 is your best buy!

See and try these popular RIDGID Threaders...at your Supply House.

THREADED PIPE...It's Tight...It's Best...Costs Less!

Free literature

Begins on page 122

chine weighs 30 lb and is available in 5- and 10-hp models. Curtiss-Wright Corp, Santa Barbara Div

184 **Engine** developing 1000 hp, suitable for emergency or portable power generation is discussed and illustrated in bulletin SAE-109. General Electric Company, Small Aircraft Engine Dept

VALVES, PIPING, FITTINGS AND SPECIALTIES

185 **Safety shutoff valve** is described in 4-p bulletin F-47. Features, applications, engineering data and operation info are given. OPW-Jordan

186 **Bronze gate valve** circular 574 illustrates screwed, solder or flanged-end valves, sizes ¼ to 3 in. Lunkenheimer Company

187 **Damper regulator** which also regulates fans, stokers, oil- and gas-control valves, suitable for use in boilers operating at pressures from 5 to 150 psi, is described in catalog sheet. Atlas Valve Company

188 **Plastic dail flow tubes** are featured in 4-p bulletin 151.20-1. B-I-F Industries

189 **Steel-tubing tolerances** chart covers seamless and welded mechanical tubing and seamless and welded stainless-steel tubing and pipe. Peter A Frasse & Company

190 **Expansion joints** are the topic of 24-p brochure 60. Detailed information on sizes and weights of both convoluted and unispaned series is given along with expansion and contraction data. Associated Piping & Eng Company, Inc. Temp Flex Div

191 **Filter assemblies** are featured in 4-p bulletin A-1081. Aircraft Porous Media, Inc

192 **Discharge drainers** are discussed in publication 5201-A. Drainers described are of ball-float-actuated rotary-valve design and are recommended for steam, compressed-air and gas service. Cochrane Corp

193 **Pipe-wrap tape** brochure is a 6-p listing of product data, pipe-wrap coverage and specifications. Permacel

194 **Utility ejectors** are topic of 4-p bulletin 9046. Units handle wet, dry mixtures or mixtures containing solid materials. They are designed to operate with steam or gas at 75 to 200 psig. Ingersoll Rand

WATER TREATMENT

195 **Sanitary engineering** equipment for water, sewage and industrial-waste treatment is listed in a 2-p

Free literature

Begins on page 122

booklet 2617 containing illustrations and photographs. Link-Belt Company

196 **Evaporators** are detailed in a 12-p product bulletin HYT-101. Tables, drawings and photographs are included. Yuba Consolidated Industries, Inc

197 **Chemical-analysis** equipment which can determine phosphate concentrations down to 0.01 ppm is described in a methodology sheet. Technicon Controls, Inc

198 **Automatic analysis** equipment which can determine silica traces down to 0.001 ppm is discussed in a methodology sheet. Technicon Controls, Inc

MISCELLANEOUS

199 **Conversion-factors** reference table in wall-chart form includes conversions such as inches to centimeters, watts to hp, atmospheres to Kgs/sq cm. Precision Equipment Co

200 **World-wide guide** to equipment and technical services is offered in 68-p illustrated book. Contains lists of representatives and addresses in various countries plus 77 categories of products and services. Dresser Industries, Inc

New Yorkers in '58 had cleaner air to breathe

Despite the growing number of air-pollution sources, New York's air was cleaner last year, reports city's Dept of Air-Pollution Control. Enforcement policies were stricter in the sixth year of the Department's history, with 754 summonses and 4293 violation notices served. A special-activities unit now patrols the waterfront for marine violators. Burning of demolition debris takes place far out on Lower Bay, and only when the wind will carry pollutants out to sea.

Six of the eight major gaseous pollutants found in New York's atmosphere were reduced in 1958, and light solids which remain suspended in the atmosphere for long periods of time decreased by 30%. But sootfall—pollutant which settles out of the atmosphere and is not breathed—increased in '58, so New York housewives may have dirty curtains to complain about for some time to come.

no more knuckle-busting . . .

New RIDGID No. 450

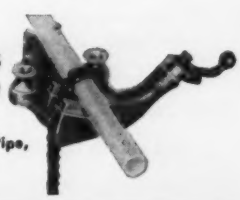
Portable Tristand Chain Vise

has Large, Easy-to-Operate Top Screw Handle right up on top

Here's a real time saver. Not only do you get a complete workbench that's truly portable, but now you get a chain vise that's extra easy and fast to operate. Handle is right up on top where it's always handy. Handle and tightening nut are anchored to vise base . . . can't pull out.

Vise base, that overhangs front legs for clear tool swing, has hanger slots for tools, 3-size pipe bender, rear pipe rest and adjustable ceiling brace screw. Folding legs and integral tray set up easily and lock in position for rigid work base. Snap chain holds folded legs closed for easy carrying . . . no loose parts. Rubber grommets in tristand feet prevent creeping. See and try this more-for-your-money RIDGID Top Screw Chain Vise at your Supply House!

New RIDGID Bench Chain Vises
have same Extra-Efficient Top-Screw Adjustment

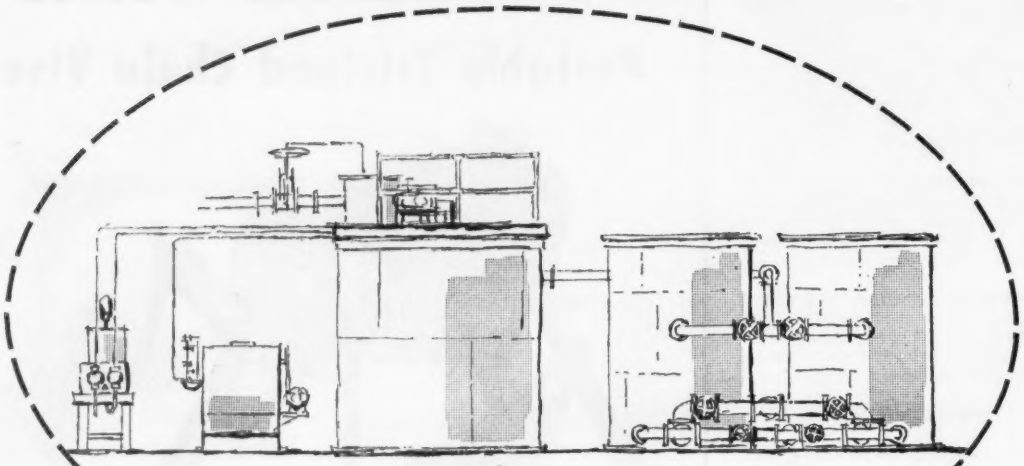


5 Sizes for ⅛" to 8" Pipe, Conduit or Rod

The Ridge Tool Company, Elyria, Ohio, U.S.A.

For more facts circle 281 on Reader Service card, p 121

A complete "package" water treating plant...



the

ACCELAPAK®

plant

COMPLETE—from inlet to outlet—nothing else required.

ADAPTABLE—for clarification, softening, iron or color removal, and sterilization. Pressure or gravity filters, as required.

STANDARDIZED—pre-engineered in all sizes with standardized dimensions in capacities from 15 to 350 gpm.

SIMPLE—working parts, easily accessible for minimum required attention. Simple erecting and operating instructions.

DEPENDABLE—treatment results are easily obtained; uniformly and dependably maintained.

ECONOMICAL—costs of plants are low due to quantity purchasing and production; installation space is small; maximum utilization of treating chemicals is assured.

9401

Write today for full details on the "ACCELAPAK" plant in Bulletin 1870-A or request Bulletin 80 showing our complete line of water and waste treating equipment.

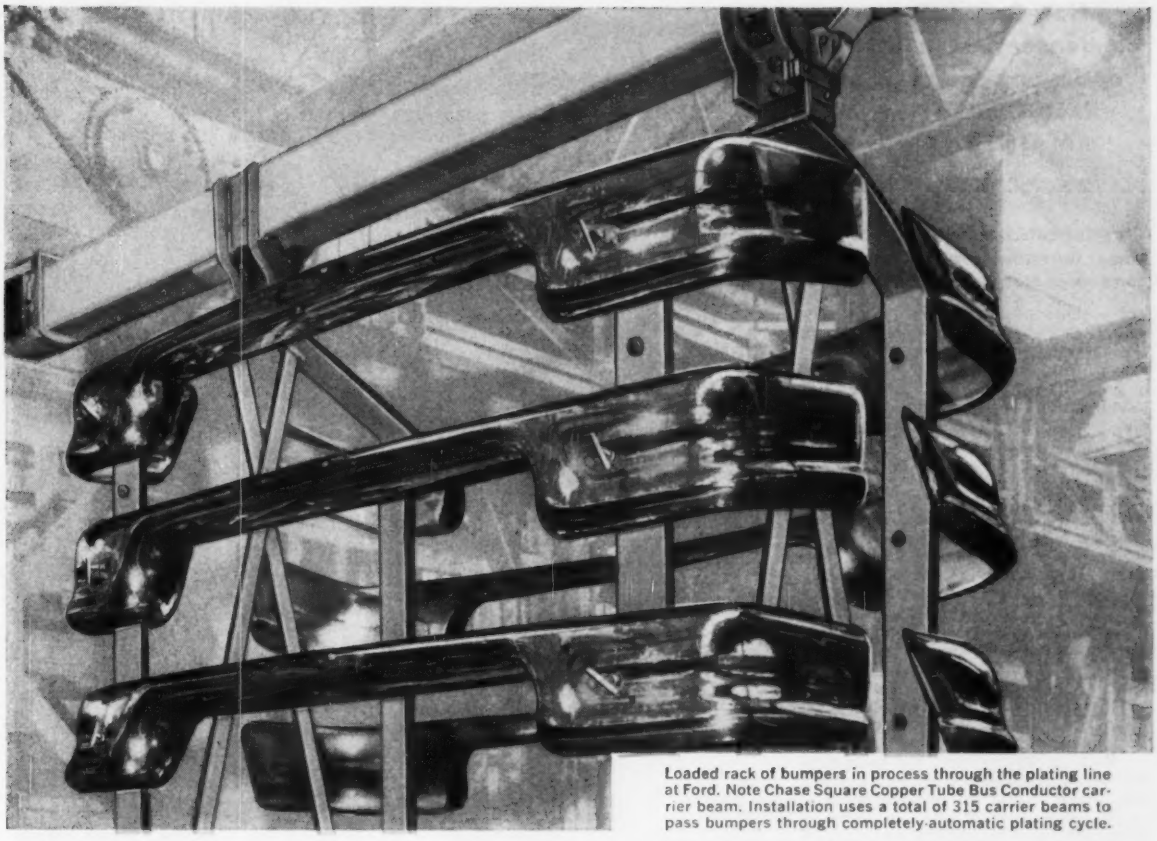
INFILCO

INFILCO Inc.

General Offices, Tucson, Arizona

Field offices throughout the United States and other countries.

For more facts circle 282 on Reader Service card, p 121



Loaded rack of bumpers in process through the plating line at Ford. Note Chase Square Copper Tube Bus Conductor carrier beam. Installation uses a total of 315 carrier beams to pass bumpers through completely-automatic plating cycle.

UNIQUE BUS CONDUCTOR INSTALLATION OF CHASE® COPPER SERVES DUAL PURPOSE AT FORD PLANT

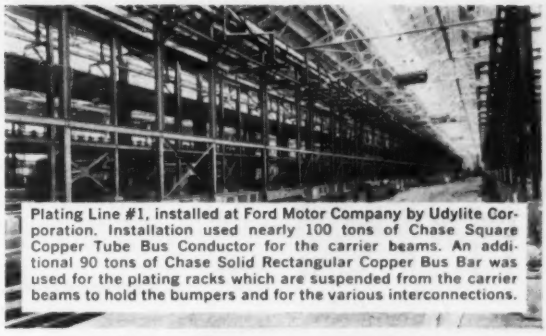
On the vast plating lines handling automobile bumpers at Ford Motor Company, Chase Square Copper Tube Bus Conductor is serving in an all-new way. Each carrier beam is made of Chase Square Copper Tube Bus Conductor 6″ square x ½″ wall x 13′5″ long.

First, the square copper tube bus conductor replaces a complex beam, formerly fabricated of several solid copper bar members. It performs the dual function of carrying the electric current and serving as a structural support from which the plating racks are suspended…thus effecting economies in fabrication, installation and operation of the lines. Space is saved; operations and maintenance are simpler and more efficient.

Second, Chase Square Copper Tube Bus Conductor carries electrical current…with these advantages:

- **high electrical and thermal conductivity**
- **high current carrying capacity**
- **great mechanical strength in all directions**
- **efficient method of connection**
- **ease of assembly and erection**

However *you* use copper bus conductor, your nearest Chase office can serve you; or write Chase at Waterbury 20, Conn.



Plating Line #1, installed at Ford Motor Company by Udylite Corporation. Installation used nearly 100 tons of Chase Square Copper Tube Bus Conductor for the carrier beams. An additional 90 tons of Chase Solid Rectangular Copper Bus Bar was used for the plating racks which are suspended from the carrier beams to hold the bumpers and for the various interconnections.

Chase®

BRASS & COPPER CO., WATERBURY 20, CONN.

Subsidiary of ***Kennecott Copper Corporation***

CHASE ELECTRICAL CONDUCTORS
are available in a variety of shapes to suit every power-carrying need.

THE NATION'S HEADQUARTERS FOR **ALUMINUM • BRASS • BRONZE • COPPER • STAINLESS STEEL**

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

How C. H. Wheeler condenser design provides optimum deaeration and REDUCES STATION MAINTENANCE

An informative advertisement from one of the nation's most experienced condenser manufacturers

The problem of power plant steam system maintenance involves many things including cleaning the water and steam sides of condenser tubes, tube damage caused by impact of water in exhaust steam, tube abrasion resulting from sand or grit in the circulating water, tube plugging resulting from foreign matter in the circulating water, and deposits in the boiler.

One of the most important ways to reduce station maintenance requirements is to improve deaeration. Excess air in condensate results in corrosive oxide deposits in the boiler which decrease its efficiency. During 56 years of condenser design and manufacturing, C.H. Wheeler has developed a number of ways to produce deaerated condensate *in the condenser*. In special designs, they maintain oxygen content of less than 0.01 cc. per liter. Oxygen levels of far less than 0.01 per liter are often achieved in C.H. Wheeler Condensers, depending upon the amount of air leakage of the system and the amount of contaminated returns.

Basic causes of oxygen and other non-condensable vapors in condensate are system leaks, heater returns and make-up water.

Full deaeration of make-up water requires bringing it up to the temperature of the steam, so that the condensate is 100% saturated with water vapor and all gases have been driven from solution. However, to be sure that no gases are mechanically entrained in the droplets of water, the water must be agitated thoroughly to permit release of any remaining air bubbles.

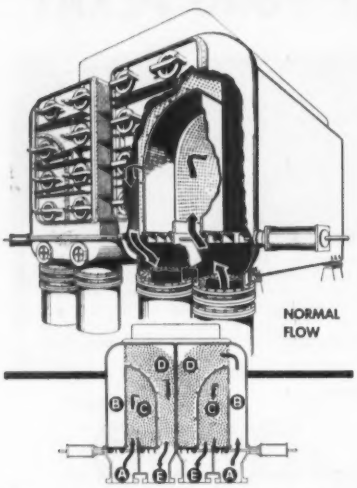


Figure 1: Schematic diagrams of C.H. Wheeler Reverse Flow.

In C.H. Wheeler Condensers, normal make-up water is heated to steam temperature and agitated to release non-condensables by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above the tubes protect them from water impingement damage. Heater drips are sprayed in the steam lanes to permit flashing and release of entrained gases.

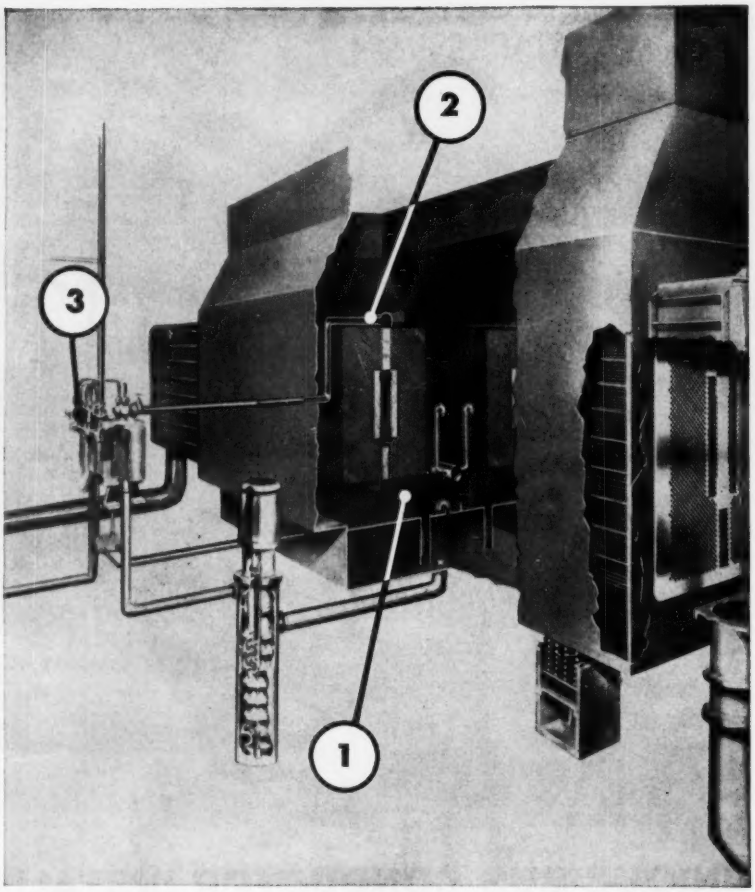


Figure 2: Cutaway drawing of portion of C.H. Wheeler Dual Bank, Divided Water Box Condenser.

Condensate is cascaded over deaerating bars (1, in Figure 2) in the presence of a moving blanket of steam, to provide proper agitation and reheating before it is drained into the hotwell. The Tubejet® Air Ejector (3) draws off non-condensable gases through the air-vapor suction line (2), and discharges them to the atmosphere. Central location of the air cooler section reduces depth of steam penetration and resistance to steam passage, achieving a new low in condenser pressure loss.

Another Big Problem—Tube Cleaning

If your water supply is polluted, condenser tube deposits may become troublesome. There are several ways to correct this situation: Shooting small slugs through the tubes with high-pressure water, using acid and chlorinating the circulating water, among other methods.

One method particularly successful in removing algae, and foreign matter such as twigs, leaves and scale, is Reverse Flow (see Figure 1). Developed by C.H. Wheeler, it makes possible the flushing of tubes and sheets without shutting down the condenser.

Here's how Reverse Flow works: Normal operation is shown on the left. Water enters through inlet A with right inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser, and then it discharges at E.

The right side of the diagram shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

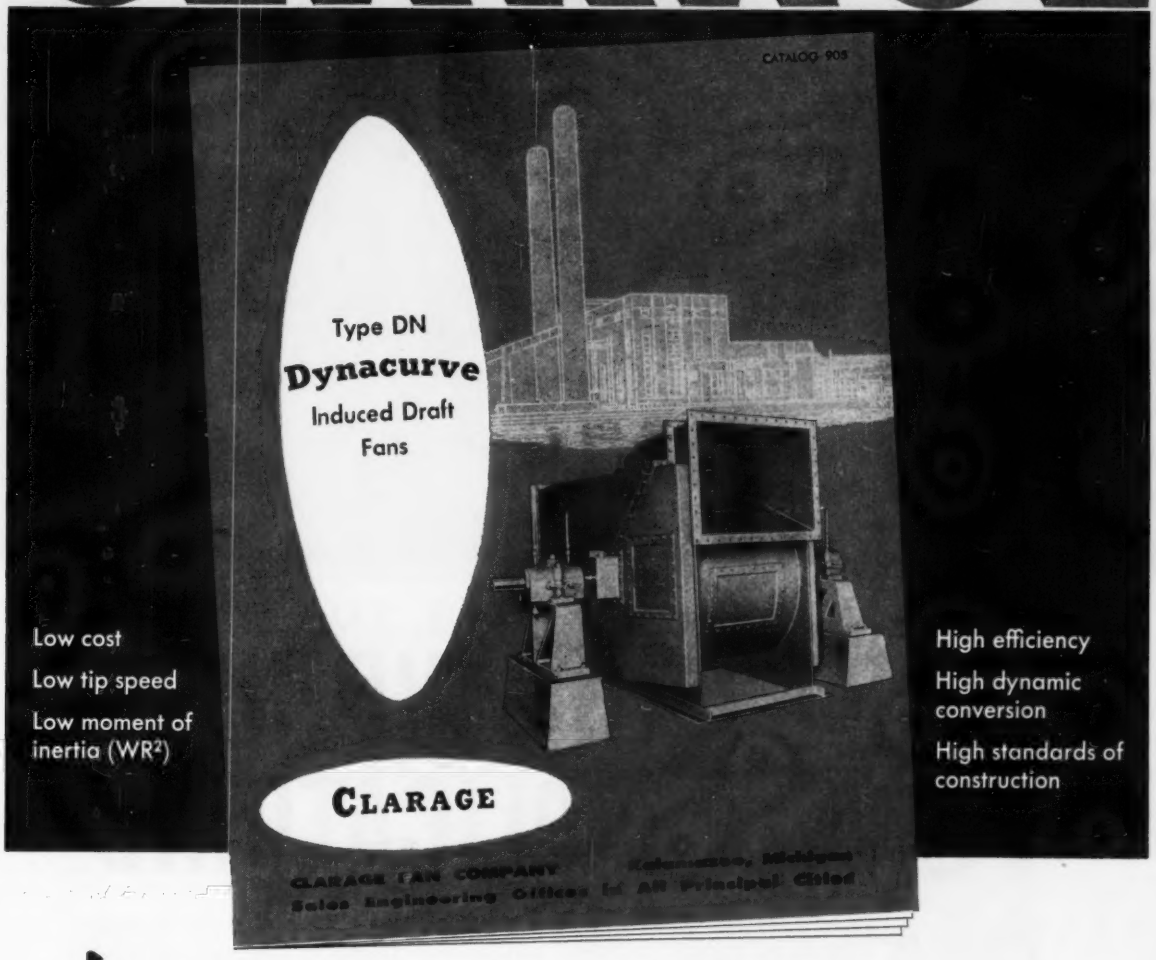
C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

CLARAGE



Learn more about the stand-out fan in the induced draft field

Request Catalog 905 or contact the nearest Clarage sales engineering office.

Dependable equipment for making air your servant

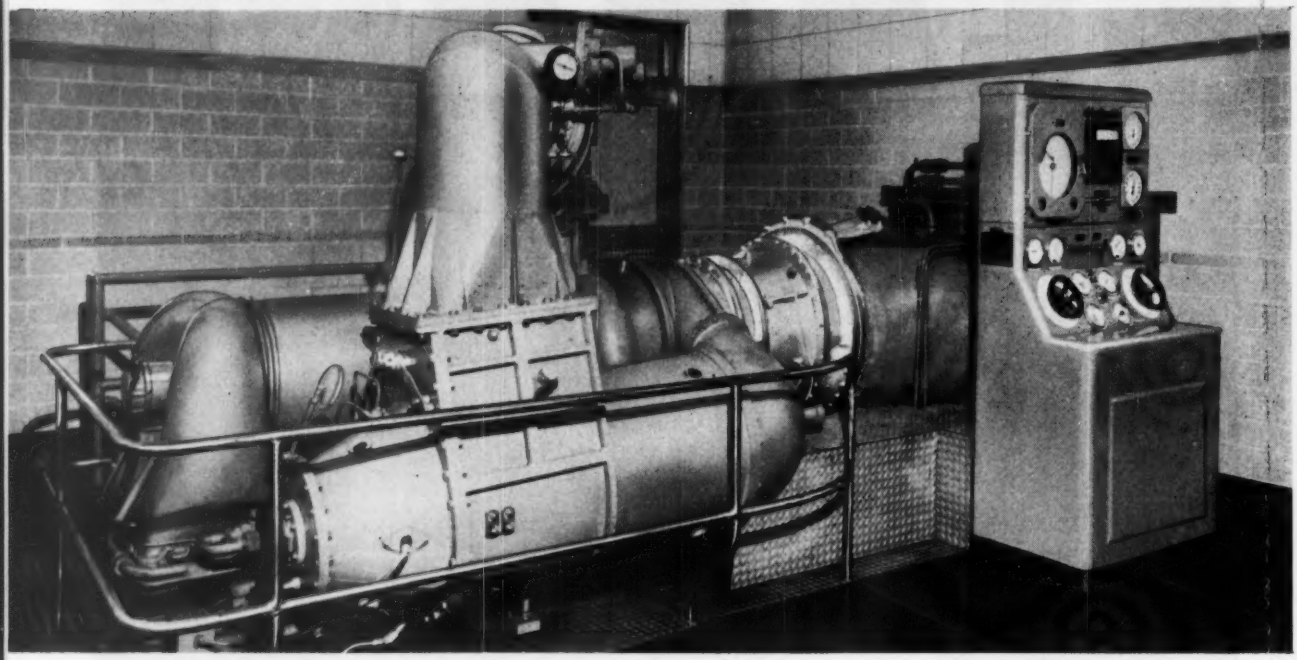
CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

For more facts circle 285 on Reader Service card, p 121

FIRST **IN PRODUCTS PIPELINING** — Up to 100,000 b/d are moved by a centrifugal pump powered by this Clark Mark TA Gas Turbine in a major products pipeline company. The Mark TA and pump do the same amount of work as two three-stage pumps in series driven by 800-hp diesels . . . and require less space, less maintenance.



CLARK MARK TA GAS TURBINES

FIRST FOR FIVE NEW POWER APPLICATIONS

A products pipeline, two widely differing mining operations, a catalytic cracker, a gas/gasoline plant join the trend to gas turbines for power in field and plant applications. And they choose the Clark Mark TA Gas Turbine because this lightweight packaged unit is demonstrating dual advantages and economies. Power generation is a prime function, but as an operating bonus, its hot exhaust gases can generate process steam, hot water and air.

There are sound reasons for the growing popularity of Clark Gas Turbines. An efficient, single combustion chamber—using gaseous or liquid fuel—provides the design simplicity and dependability required for long service life with minimum maintenance. Thermo-elastic design makes it possible to accept full load quickly without stress. Dual-shaft construction assures maximum speed flexibility for process use. Air cooling makes Clark Gas Turbines ideal for locations where short water supply is a problem.

The Clark Mark TA Gas Turbine is conservatively rated at 1220 bhp, with a normal output speed of 6000 rpm. Three other standard speed models are available. For applications requiring more horsepower, Clark 302 and 305 Gas Turbines are rated up to 9300 bhp.

Your nearest Clark representative has full information on all Clark Gas Turbine models. Or simply write for Bulletins 162 and 163-1 to Clark Bros. Co., 2530 Lincoln Ave., Olean, N. Y.

CLARK

CLARK BROS. CO.

OLEAN, N. Y.

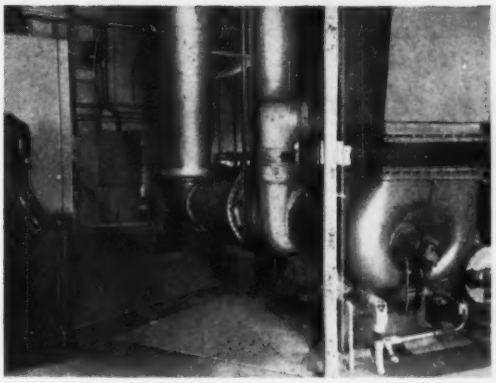
One of the Dresser Industries

COMPRESSORS · ENGINES · GAS TURBINES

For more facts circle 286 on Reader Service card, p 121

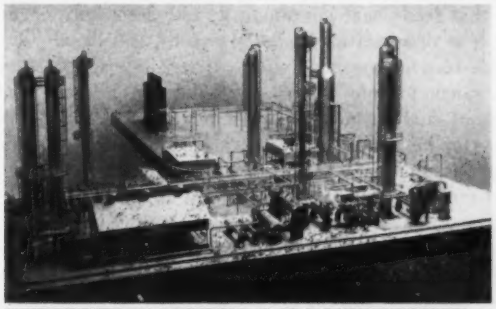
FIRST IN OFFSHORE SULPHUR MINING

Seven miles out in the Gulf of Mexico, Freeport Sulphur Company uses a Clark Mark TA as prime mover in the production of molten sulphur from a deposit 2000 feet below the surface of the Gulf. The Mark TA by driving an electric generator produced power for the drilling rig that put down the production wells (this is the first time a gas turbine has been used on an electric rig). After the main power plant is on stream, the Mark TA will continue in service: (1) Producing part of the plant electrical power used for many vital functions including powering the Clark Balanced/Opposed Compressors supplying the air which lifts the molten sulphur to the surface, (2) Supplying the boilers with hot combustion air which, the supplementary fuel, will generate the steam necessary to heat 5 million gallons of water per day used to melt the sulphur deposit.



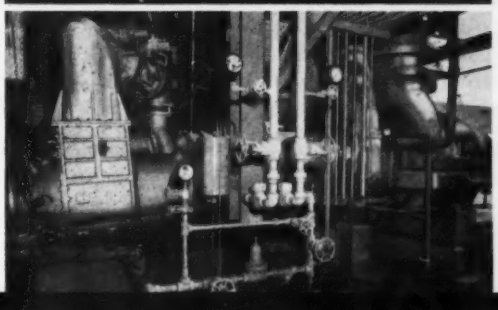
FIRST IN OPEN PIT MINING

This Clark Mark TA driving a generator not only supplies electricity for operation of the Greybull, Wyoming, installation of the Magnet Cove Barium Corporation, but in addition its exhaust gases are used for drying ore. Even discounting the ore-drying bonus, the mine manager reports "better than anticipated fuel economy."



FIRST IN GAS/GASOLINE PLANT

All electric power requirements plus generation of process steam in a waste heat boiler will be accomplished by a Clark Mark TA in the gas processing plant now being constructed for Sun Oil Company near Laverne, Oklahoma (model shown). Initial plant capacity is rated at 100 M.M.s.c.f.d. A projected 50 percent expansion can be accomplished with the same power unit.



FIRST ON A SMALL CAT CRACKER

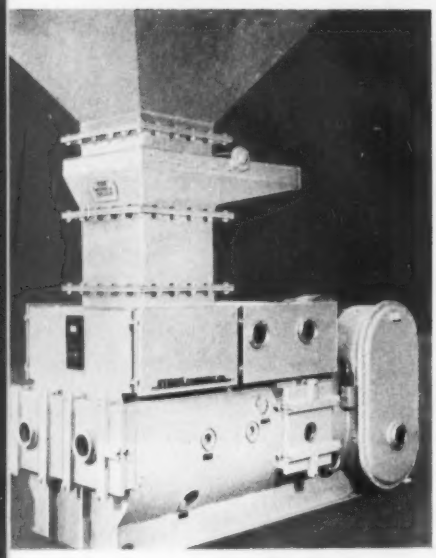
This Clark Mark TA, mounted outdoors, drives a cat cracker blower supplying air directly to a catalyst regenerator at the Duncan, Oklahoma, refinery of DX Sunray Oil Company. Though larger gas turbines have been used in this manner before, the Mark TA is demonstrating the efficiency of smaller applications. The Mark TA Gas Turbine is available through a licensing agreement between Ruston-Hornsby Ltd., Lincoln, England, and Clark Bros. Co.

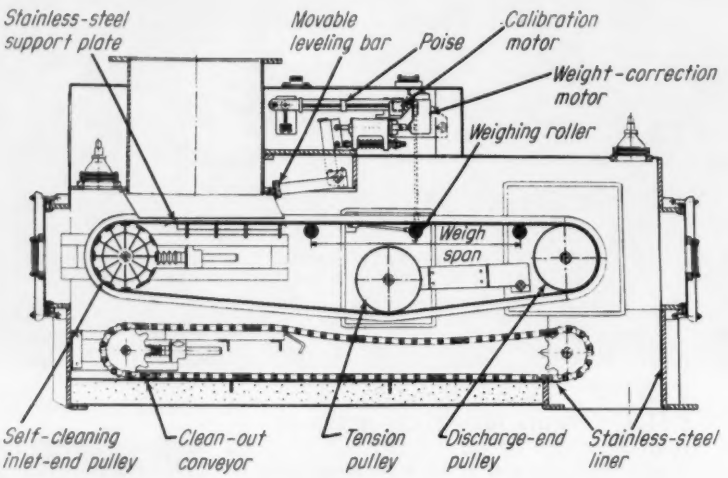
EXCLUSIVE

Equipment design of the month

On this page each month you will see the wraps taken off a significant new product at least 30 days before it's released to any other publication, and before it's advertised anywhere

By STEVE ELONKA
Associate Editor





Now, continuous coal feed, by *weight*, from one unit

Feeding coal to pulverized-fuel and cyclone-fired units by *weight* instead of by volume, as has been the practice, yields higher accuracy. In turn, this makes possible: (1) closer control of air-fuel ratio (2) equal division of fuel flow among the several firing units of a single boiler and (3) direct regulation of the rate of coal feed by combustion-control-system impulses.

The new *S-E-Co* gravimetric feeder does just this, combining usual functions of a coal scale and feeder in a single unit that feeds coal continuously and accurately, by *weight*. It is designed to discharge exactly 100 lb of coal for each turn of the head shaft. Head-shaft speed is thus equivalent to rate of coal feed and can be expressed as lb of coal per minute or per hour, as desired. Instruments can be provided to indicate coal feed rate and total coal burned.

Each feeder is driven by a variable-speed motor. Control for that motor balances the speed of its output shaft against an electrical voltage furnished by the combustion control. This assures a coal-feed rate that corresponds exactly to combustion requirements.

As indicated in the drawing, above, a short length of the special feeder belt is supported on two fixed rollers. In the center of the weigh span so formed there is a third "weighing" roller linked to a lever scale above. The poise on this scale arm is positioned so entire system is in balance when weight on center roller is exactly one-half weight of coal between the weigh-span rollers.

Length of the weigh span is equivalent to belt advance for one turn of the head shaft. Since unit is designed to discharge 100 lb per turn, system is in balance when the weighing roller carries exactly 50 lb. If instantaneous weight of coal on weigh span is more or less than the set figure, scale arm moves slightly to close "overweight" or "underweight" contacts. These actuate a motor-driven leveling bar that regulates volume of coal on the belt.

Poise on scale arm is positioned by a calibration motor and screw. A selector switch allows this motor to be controlled by the "overweight" and "underweight" contacts. Simple calibration procedure involves only hanging a 50-lb test weight on the weighing roller and operating for a short time without coal on the belt. Calibration motor is actuated by the weighing contacts to move the poise to exact point of balance. Method automatically takes into consideration tare weight of the belt.

For pulverized-fuel units the feeder body is a cylindrical housing that meets NFPA *Code* requirements. For cyclone units a dust-tight rectangular housing is designed for an internal operating pressure of 2 psi.

A belt volumetric feeder has also been developed.

For additional information circle No. 76 on Reader Service card, page 121

3 PRESSURE CLASSES

1500-Pound ASA—in carbon steel (WCB)

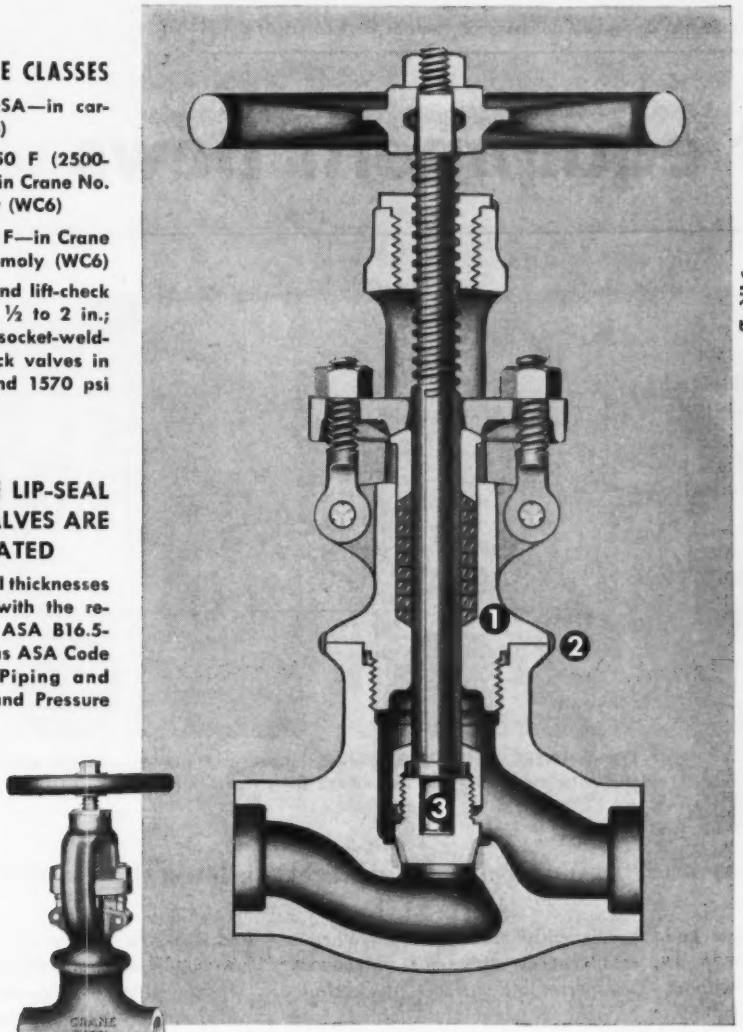
1570 psi, 1050 F (2500-Pound ASA)—in Crane No. 7 chrome-moly (WC6)

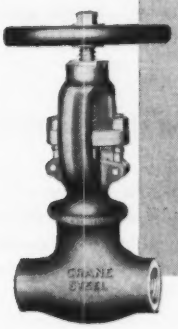
2520 psi, 1050 F—in Crane No. 7 chrome-moly (WC6)

Globe, angle and lift-check patterns; sizes ½ to 2 in.; screwed and socket-welding ends. Check valves in 1500-Pound and 1570 psi ratings only.

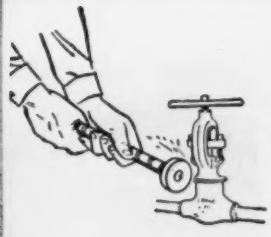
ALL CRANE LIP-SEAL BONNET VALVES ARE ASA-RATED

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957, as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.





1 New centering shoulder assures perfect body-bonnet alignment. No chance of stem misalignment.



2 Welded body-bonnet Lip-Seal—eliminates bonnet joint maintenance. The seal-weld carries no mechanical load; it seals the bonnet joint only. Lip design permits convenient grind-off, easy rewelding.

3 Disc-stem connection. Improved design brings stem thrust closer to seating surface, minimizes vibration, does not interfere with swivel action of disc.

Today's ultimate in small high pressure valves —Crane Lip-Seal Bonnet Globes

These *accurately rated*, small high pressure valves—now in *three* pressure classes—meet all power plant service specifications for boiler feed, drips and drains, blowdowns, bypasses, and similar applications.

Here are compact yet rugged valves that provide precision throttling with minimum vibration of disc and reduced wear on seating faces—all with *low maintenance cost.*

The patented Lip-Seal bonnet alone gives these valves outstanding value. Strong, streamlined body . . . Stellite-faced, plug-type disc and seat . . . fully guided stem and disc . . . 2-piece, ball-type packing gland with stainless steel, swing-type eyebolts . . . these and more refinements all combine to make Crane Lip-Seal Bonnet Valves today's ultimate in their class.

For complete details, ask your Crane Representative for Bulletin AD-2373 or write to address below.

Ask for Bulletin AD-2373

CRANE® VALVES & FITTINGS

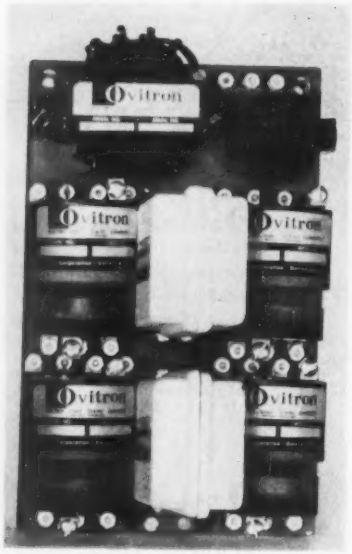
PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

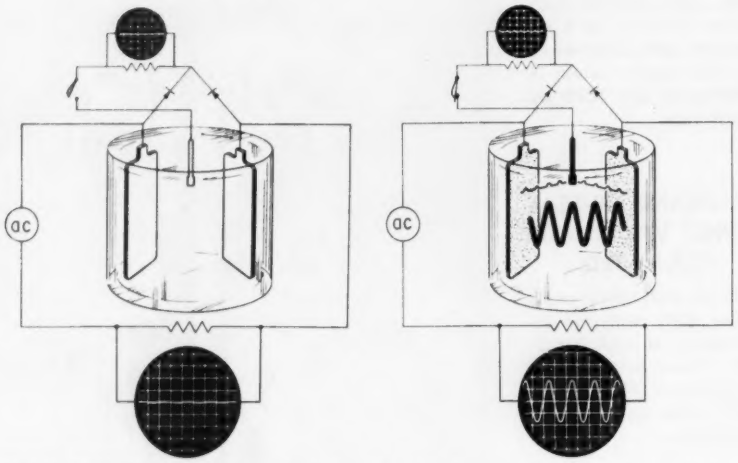
In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

For more facts circle 287 on Reader Service card, p 121

Plant equipment news . . . Your



STATIC CONTROL RELAY permits combinations of normally open or closed poles



SMALL ENERGY STIMULUS, applied through grid element, changes surfaces of electrodes to conductive state so ac can flow, *right*. Unenergized device is shown, *left*

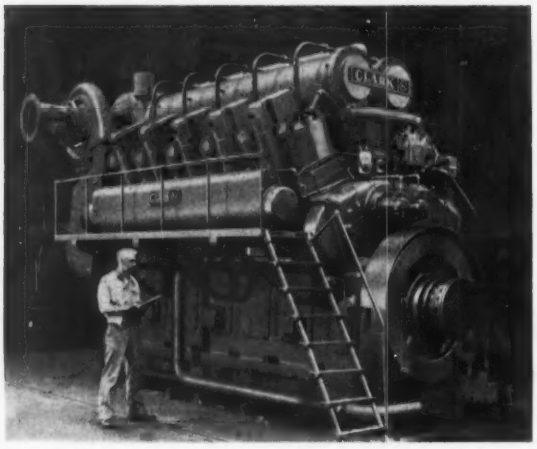
Electrochemical relay is latest static switch

1 • Static device can switch and modulate almost any amount of ac endlessly and continuously—without wear, disintegration or loss of efficiency and without moving parts or magnetic coils. It's ready to tackle high-power circuit control.

Unit consists of two load-connected electrodes and a grid control, above, immersed in electrolytic bath and permanently encapsulated. When a small energy stimulus is introduced, semipermeable surfaces of electrodes become permeable to some ions, change to conductive state so large amounts of ac can flow. When control signal is removed from grid, electrodes' load-carrying surfaces immediately become nonconductive.

Self-energized excitation uses two diodes, which can be small because they handle only control current.

High-wattage load current is controlled entirely by small energy stimulus, and full-on, full-off switching or modulation is possible. Present rating is 70 v. Potential applications include circuit breakers, regulators, time delays and proximity switches. —Ovitron Corporation



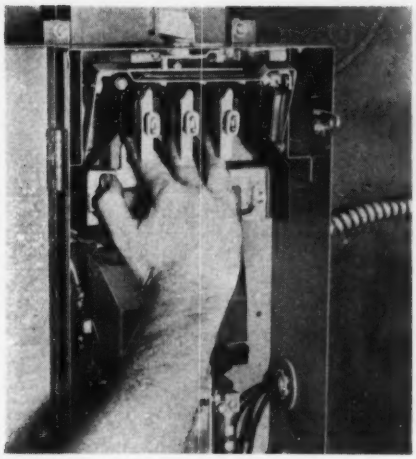
V type 2-cycle gas engine is compact, reliable

2 • High-hp driver will see service in power generation, as a driver for pumps or centrifugal compressors in pipeline booster stations. *Model TPV* is a V type turbocharged 2-cycle gas engine. It has 17x19-in. bore and stroke, comes in 10-, 12- and 16-cylinder sizes rated at 4000, 4800 and 6400 bhp.

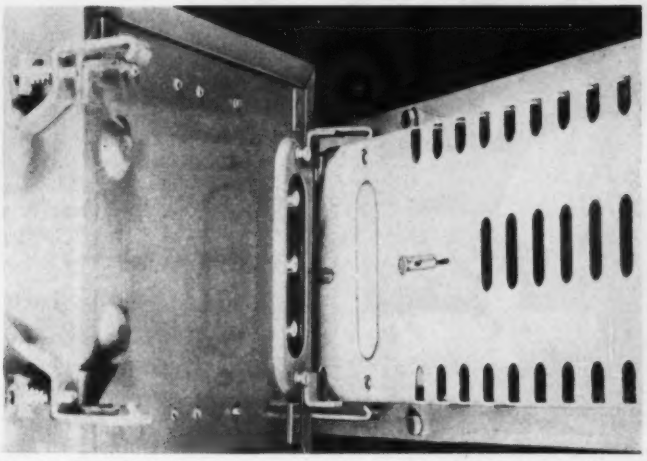
Engine is said to combine low fuel consumption with 2-cycle simplicity—2/5 of parts needed for comparable 4-cycle engines are eliminated. It operates at 40% thermal efficiency. More hp in less space, dependability to minimize downtime are features, manufacturer states.

Bmep rating is 110 psi, promising low stress, long component life, reliability and good reserve capacity for temporary overloads. The jet-air-started turbocharger is self-sustaining under normal conditions.—Clark Bros Co

information center for new products and materials



LIVE PLUG carries 220 v, but worker can touch primary contacts—opening cover clears them from bus



PLUG-IN DEVICE easily clamps to energized bus feeder or other part of system. Current-carrying parts are never accessible during installation or operation

Total safety promised by this electrical-distribution system

3 • New concept in electrical distribution completely isolates personnel from live parts and accidental electrical contact. Live power, plug-in convenience can be brought right to working level with perfect safety, according to manufacturer.

Unique protection features a "safety-slide" opening and retractable plug-in contact. Safety slide covers bus bars, can't be opened until plug-in branch circuit unit is installed on busway, above, right. Once plug-in device is installed, with safety slide open, interlocks prevent removal. Retractable stabs make contact with bus bars when handle is "on"; then door to plug-in unit can't be operated. Closed safety slide means unit is completely dead for safe removal.

Total-safety concept is carried through system: safety-slide outlet is brought down to working level in motor control centers, switchboards, motor starters and enclosed switches.

Close spacing on bus bars maintains low voltage drop for efficient transmission. A duo-circuit arrangement gives high momentary short-circuit strength, low impedance. All components are standardized for system flexibility, have common ratings and dimensions. Compact subdistribution centers receive various plug-in units—available with combinations of fuses, switches, air circuit breakers, motor controls, transformers, capacitors, ground-detectors—Electric Distribution Products, Inc.

Foaming solvent for industrial cleaning does thorough job

4 • A small amount of chemical solvent is expanded 20 times to make a low-cost lather for industrial cleaning. Where liquid chemicals are too heavy or create too much pressure for complex equipment, lightweight foam solvent may be the answer. Foam completely fills every loop and bend of equipment and carries away dirt particles.

Solvent lather is pumped directly from foam generator to tank, pipe or tower to be cleaned. When vessel is filled with foam a cycle begins: foam passes through foam breaker, a filter removes waste, then solvent is recycled through generator and back to unit being cleaned. Foam density is regulated. Tests tell when cleaning is done.

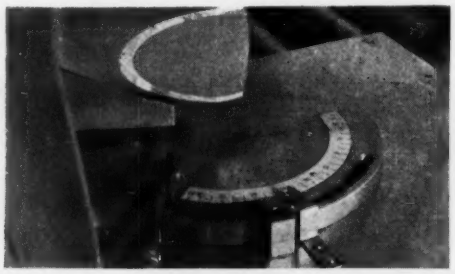
Generating equipment fits on a small truck. There's no after-rusting because cleaned metal surfaces are not exposed to air—foam solvent is displaced directly with rinse followed by foam passivator. Applications include heat-exchange and process equipment and pipelines.—The Dow Chemical Company, Dowell Div

For more data on these developments, circle key numbers on Reader Service card, p 121

More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 121

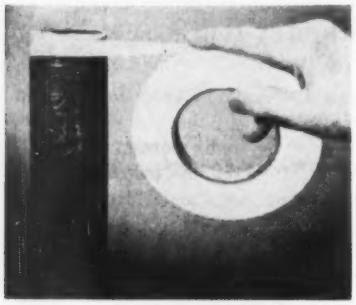
ALUMINUM JOINT—45 deg intersection in 4-in. standard-weight pipe—can be prepared and cut in just 2¼ min



PIPE IS SET according to chart, positioning fixture is indexed and you're ready to cut a clean joint

Turn out ready-to-weld joints—fast

5 • Joints are cut in any metal with a minimum of work using new joint-preparation tool. It takes only minutes for an unskilled operator to prepare and cut clean machined pipe or tube ends. Finished joint has "built-in" welding groove. A copyrighted chart shows you how to set pipe and machine for 35 to 90 deg cut without templates.—Wallace Supplies Mfg Co



Teflon ribbon seals pipe at pressures to 10,000 psi

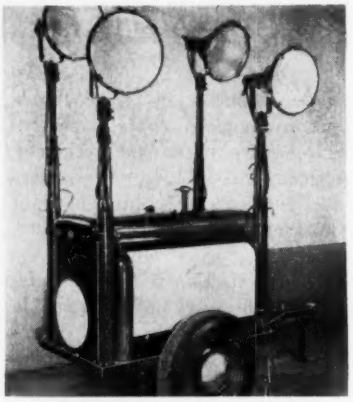
6 • Thread-sealant ribbon will seal any threaded pipe—plastic, stainless steel, copper, brass or galvanized. Ribbon is a compressible solid; it molds itself to threads of pipes, stud bolts, bungs. On plastic and aluminum pipe it acts as a self lubricant, prevents seizing.

Good thermal stability means ribbon *No. 26* can be used effectively at continued operating temperatures from −450 to +500 F, maker states. Application is easy and clean with no drying or waste. Teflon is inert to most reagents so there's no contamination.—Fluoro-Plastics, Inc

Industrial stethoscope handles many jobs for you

7 • Rugged but sensitive instrument detects sounds otherwise inaudible, has dozens of uses around the plant in maintenance and operating departments. Some of its possible applications are diagnosing faults in machines and pipelines, tuning up motors and compressors, checking running machinery, detecting and diagnosing mechanical flaws such as loose joints, poor bearings and valves, strains and gas, air or fluid leakage.

Stethoscope is made to stand hard, everyday use, maker states. It sells for $2.95.—Edmund Scientific Co



Trailerized floodlight generates its own power

8 • Designed for nighttime fire fighting or maintenance work, the *Mobilite* is equipped with four floodlight units. Each light can be adjusted to any height up to 18 ft. Lights pivot in a complete circle.

Generator capacity is 6500 w for the 300,000-cp unit; there are eight extra outlet receptacles for operation of power tools. The 500,000-cp model has 10,000-w capacity, 12 outlets.—Pacific Mercury Company

For more data on these developments, circle key numbers on Reader Service card, p 121

Improved Water Level Indication • Better Visibility

with Exclusive New Construction*

Diamond®

MP-3000 MULTI-PORT BI-COLOR GAUGE

*Patented

New patented construction of the Diamond MP-3000 Multi-Port Bi-Color Gauge is illustrated by cut-away sections.

This improved construction (exclusive with the Diamond MP-3000 Multi-Port Bi-Color Gauges) avoids possible confusion of colors in steam space of gauge and it improves visibility by providing sharper red and green colors.

Condensate, which might otherwise be a source of trouble, flows down the bypass channel instead of down the port channel. This permits the center plate to retain a relatively high temperature so that water in the ports is nearer to temperature of water in the boiler drum, improving indication accuracy. Absence of condensate in the ports assures a distinct Bi-Color image—signal red for steam—signal green for water.

Multi-Port construction greatly reduces gauge maintenance costs. Inherent thermal stability minimizes maintenance frequency and any port can be changed in a few minutes without removing the gauge from the boiler. Change of any port is expedited by new glass and gasket package unit. Construction is exceptionally sturdy—gauge body is machined from a solid block of high grade stainless steel. Get in touch with your local Diamond office, or write us at Lancaster, Ohio, P.O. Box 415, for complete information and bulletins.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

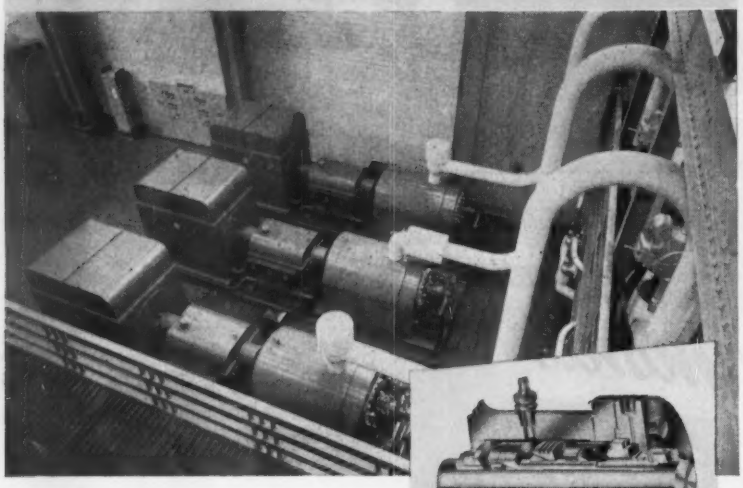
8364

DIAMOND SPECIALTY LIMITED • WINDSOR, ONTARIO

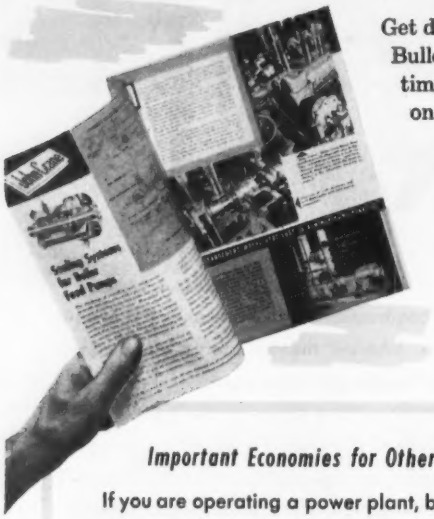
For more facts circle 288 on Reader Service card, p 121

John Crane

BOILER FEED PUMP SEALS are BRINGING NEW ECONOMY TO INDUSTRY and UTILITIES



It will be worth your while to get full information about "John Crane" Seals for your high temperature, high pressure boiler feed pumps. At numerous installations they are setting records in the saving of maintenance, feed water and kilowatt costs.



Get detailed data by requesting our Bulletin S-230. At the same time we will give facts and figures on installations now in operation.

On letterhead request, we will furnish a complete layout to meet your pump requirements. Give us make, model and serial number of your pump, plus temperatures, suction and discharge pressures.

Important Economies for Other Hot Water Service, Too!

If you are operating a power plant, boiler room, industrial or commercial hot water pump system, Bulletin S-230 can help you. Contents include full details on hot water shaft seals that offer the same cost savings as boiler pump feed seals.

Crane Packing Company, 6430 Oakton Street, Morton Grove, Ill., (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

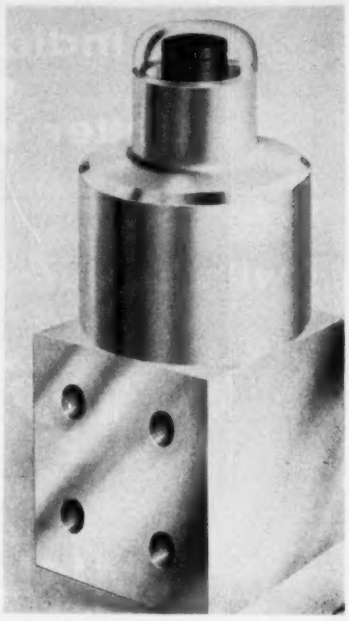
John Crane

MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

Equipment news

Begins on page 140

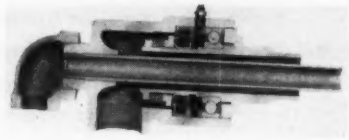


Shock indicators

22 • Reusable indicator shows when shock to shipped instruments has exceeded a predetermined permissible limit. Detection devices have complete spherical sensitivity, are also available with 1- or 2-plane sensitivity with accuracy of 5% of preset value.

Life expectancy is five years. Units are protected against tampering with inspectors' seals.—Inertia Switch, Inc

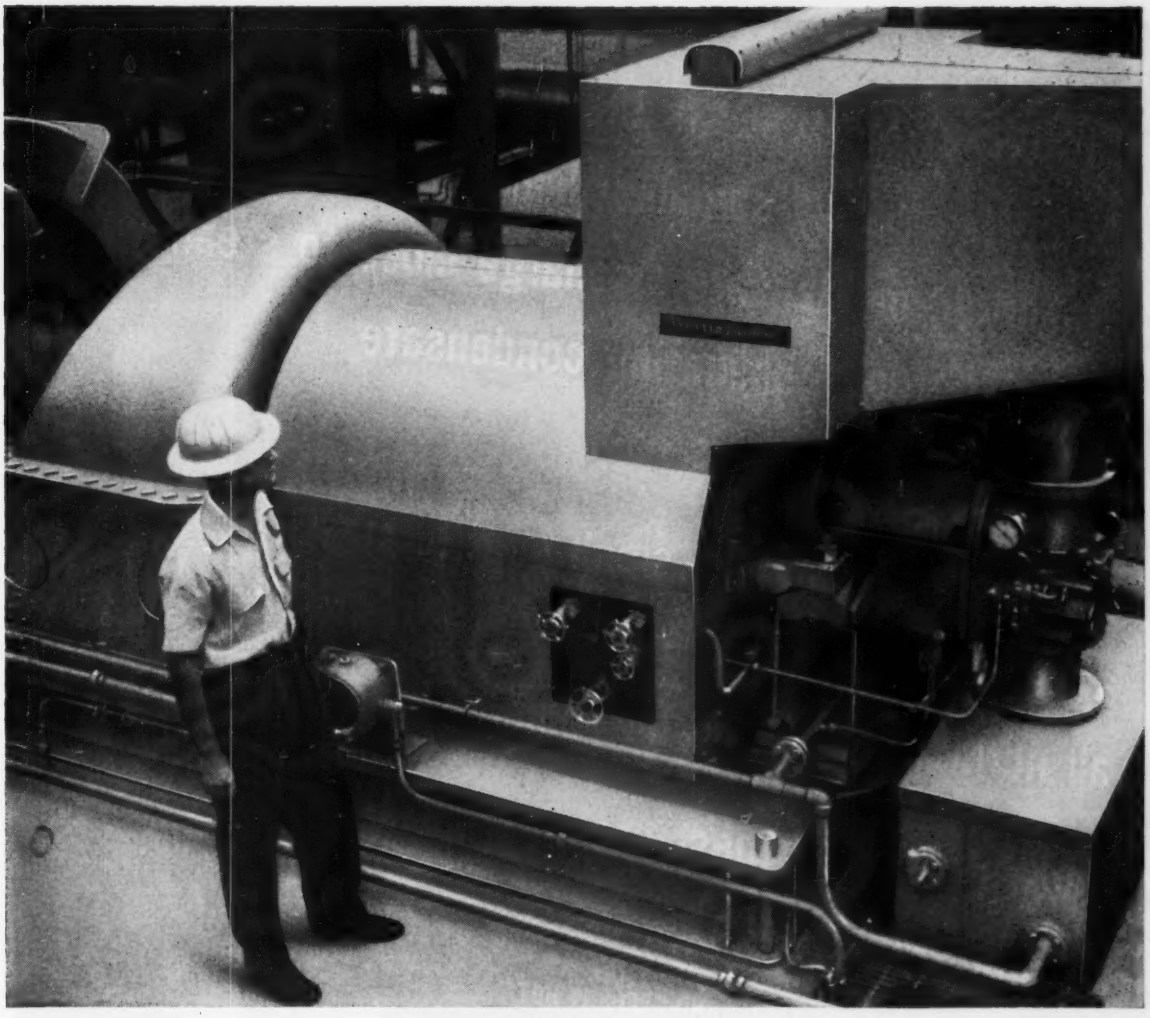
Just circle key numbers on the Reader Service card, page 121, to get complete product story



Revolving sealing connection

34 • Low friction, less wear and power consumption because of mechanical-seal and ball-bearing construction are features of this revolving sealing connection. Unit joins stationary supply pipe with revolving machine cylinder, roll or drum.

Two parallel, optically flat lapped



Westinghouse multi-stage, hi-speed turbines guarantee you

...engineered power to meet your exact needs

Why pay for power you can't use? Or, by the same token, why strain a machine beyond its capability? Westinghouse can meet your exact turbine requirements with the world's broadest line of wheel sizes and design capabilities for steam conditions through 2400 psig—1050° F at the throttle, exhausting from 1 in.hg absolute to 300 psig.*

Fitting the right wheel size to the job is the key to efficiency and economy. By knowing your process requirements, cost of steam and number of hours you expect your turbine to run during the "payoff" period, we can provide the turbine design best suited to your power and economic requirements.

To meet these varied requirements, Westinghouse has available five frame sizes of multi-stage, hi-speed turbines with wheel diameters ranging from 12 in. to 32 in. In addition, interchangeability of many wearing parts saves you money on inventories and stocking of spare parts.

Westinghouse turbine specialists located throughout the country are available at all times to provide personal attention to your heat balance problems, and are equipped to offer on-the-spot price and performance data for this entire turbine line. The capabilities of the world's largest and most modern small turbine facility are at your disposal. Call your Westinghouse representative, or write Westinghouse Electric Corporation, Small Turbine Sales, Lester Branch Post Office, Philadelphia 13, Pennsylvania.

J-50605

***WESTINGHOUSE MULTI-STAGE, MULTI-VALVE, HI-SPEED TURBINE FRAME CAPABILITIES**

Turbine Frame	M-12	M-16	M-20	M-25	M-32
Number of Stages			As Required		
Wheel Size, in.	12½	16	20	25	32
Maximum hp	4000	5000	7000	10,000	16,000
Maximum rpm	16,000	12,500	10,000	8000	6000
Maximum P_1, psig	1500	1500	1500	1500	1500
Maximum T_1, °FIT	950	950	950	950	950
Maximum P_2, psig	300	300	300	300	50
Exhaust Size, in.	20	24	30	36	48
D. F. Exh. Size, in.	30	36	48	42 x 64½	48 x 84
Max. Inlet Size, in.	5	6	8	10	12

(For special applications, inlet steam conditions to 2400 psig, 1050° F total temperature can be accommodated.)

YOU CAN BE SURE...IF IT'S

Westinghouse

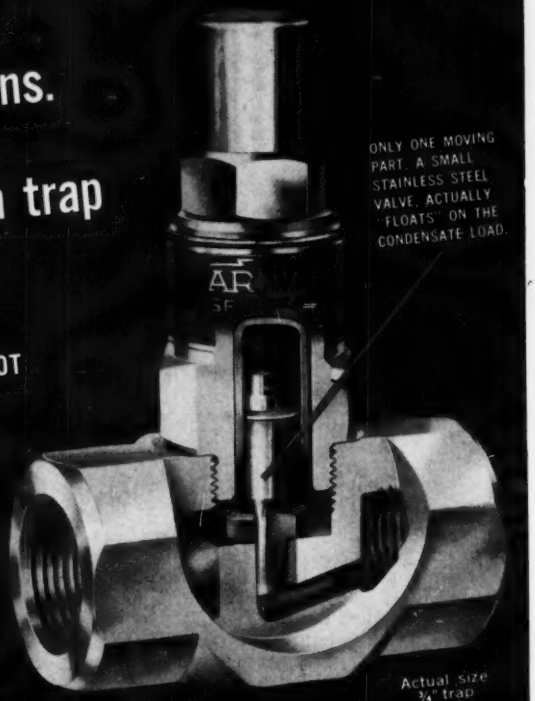
WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

YARWAY IMPULSE* is the only steam trap that continually samples fluid in the line to maintain condensate discharge close to steam temperature, eliminating condensate as soon as it forms.

Condensate seals the small control orifice against steam leakage under all normal operating conditions.

Here's why your best steam trap buy is Yarway Impulse—

1. GETS EQUIPMENT HOT FAST—AND KEEPS IT HOT
2. ONLY ONE MOVING PART
3. LOW MAINTENANCE
4. SMALL SIZE—LIGHT WEIGHT
5. GOOD FOR ALL PRESSURES
6. NON-FREEZING
7. COMPLETE LINE FOR EVERY REQUIREMENT



ONLY ONE MOVING PART, A SMALL STAINLESS STEEL VALVE, ACTUALLY "FLOATS" ON THE CONDENSATE LOAD.

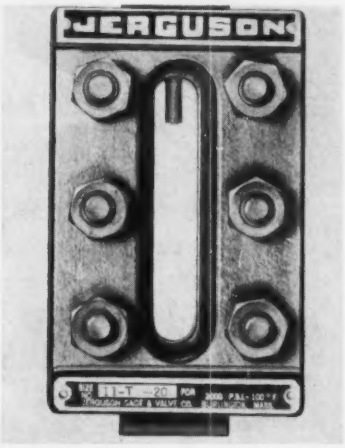
Actual size ¾" trap

* A COMPLETE LINE OF STEAM TRAPS, ALL OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE.

YARWAY impulse®

Manufactured by YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia, Pa.
Stocked and sold by 270 Industrial Distributors
Write for free bulletin "The Why and How of Steam Trapping"

surfaces run together in an opposite plane in relation to shaft axis, giving precise mechanical sealing. Pressure is automatically increased or decreased in proportion to fluid pressure. Union handles steam, water, air, vacuum, industrial fluids and gases up to 250 psi or 150-psi steam.—Perfecting Service Company



H-p drip sight feeder

50 • Designed for drip feeding under high pressure, for corrosive conditions and for temperatures from below zero to 750 F, feeder is rated 2000 psi at 100 F, 1100 psi at 750 F. A ⅛-in.-dia drip tube extends into top of a transparent flow indicator's chamber, so drop formation is easily visible. A valve with needle stem is available for hand-operated flow control. For low-temperature service feeder comes in nonfrosting design. —Jerguson Gage & Valve Co

Just circle key numbers on the Reader Service card, page 121, to get complete product story

Pipe and block insulation

30 • Temperatures up to 1600 F won't faze this expanded-silica insulation. Silica is combined with specially developed binder, inorganic fiber reinforcement. The insulation features water resistance, light weight combined with strength, easy cutting, no crumbling.—The Philip Carey Mfg Company

Screw-stem shutoff valves

37 • Leakage to atmosphere and viscous-fluid clogging of activating threads are prevented by these valves, maker states. A single Buna "N" O-ring eliminates leakage problems and maintenance costs, provides longer improved performance. Standard models can be used with fuel oil, gasoline, kerosene, air, water, mild alkalies, acids, alcohols and coolants at –40 to 250 F, up to 500 psi. Special units handle up to 3000 psi.—Anderson Brass Company

Frequency recorder

27 • Unit meets utility requirements for high-accuracy measurement in 58- to 62-cycle band. Accuracy is ±0.05 cycles. Construction is self-contained to save on mounting and wiring, according to manufacturer.

Instrument's scale is calibrated for four cycles instead of ten to give higher recording accuracy and greater chart readability. Semi-flush or surface panel-mounting types are available and there is a portable model.—General Electric Company

Just circle key numbers on the Reader Service card, page 121, to get complete product story

Copper brightener

24 • Nondeteriorating copper brightener is said to produce bright, chemically clean surfaces for printed

continued

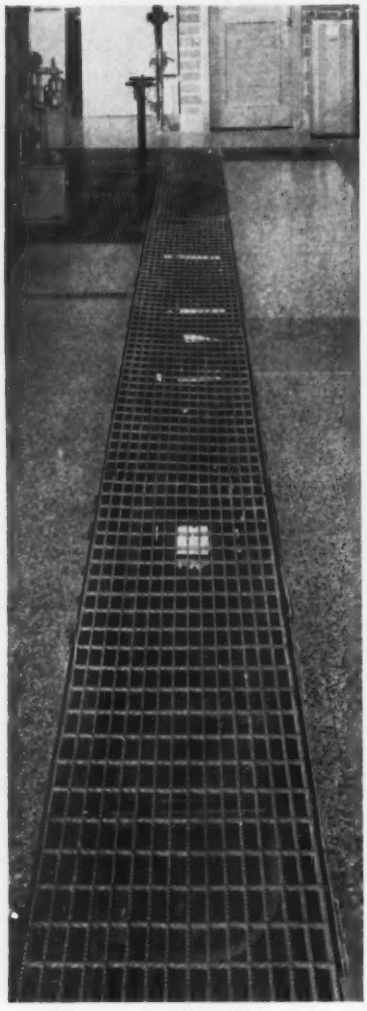
This Yarway team has scored high—over a million installed on all types of steam equipment. Stocked and sold by 270 Industrial Distributors. For free Steam Trap Book, write YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia 18, Pa.

go YARWAY with confidence

PLANT SAFETY HERE WITH KERRIGAN Weldforged TRADEMARK

OPEN STEEL FLOORING

Note serrated bearing bars . . . AN ADDITIONAL SAFETY PRECAUTION!



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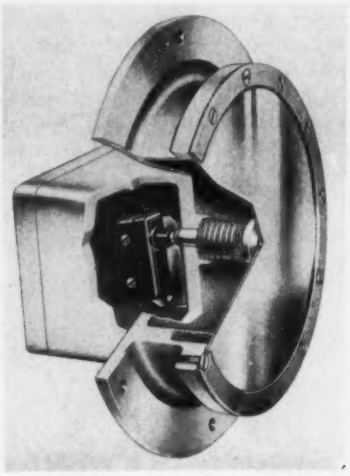
Address Dept. PO-9
KERRIGAN IRON WORKS CO.
Nashville 2, Tennessee

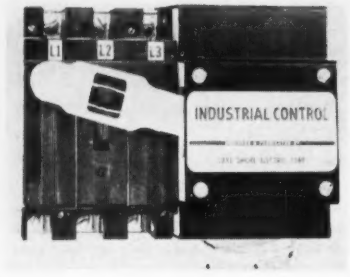
circuits, bus bars etc. It contains no strong etching acids, so is not contaminated by copper accumulation, has indefinte bath life. *Copperbrite 48* can be used cold or hot. It's odorless, easy to use.—London Chemical Co, Inc



Bin-level indicator

43 • Automatic unit is useful for service where corrosion or chemicals are present. Sensitive response mechanism works well with light or heavy materials. The indicator comes in standard or explosionproof models.—The Bin-Dicator Company

Just circle key numbers on the Reader Service card, page 121, to get complete product story

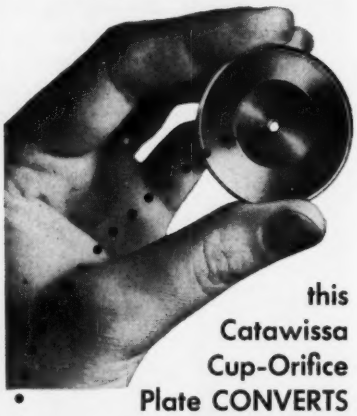


Remote circuit breaker

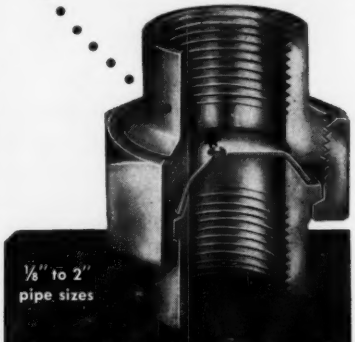
44 • Solenoid-operated breaker is used with various automatic controls for multiple-circuit mixed-load service. Capacities are 0-50 and 50-100 amp at 240-, 480- and 600-v ac, 125-

here's real **ECONOMY...**
time-saving **SIMPLICITY...**
and sure-fire **DEPENDABILITY**

for metering, measuring, controlling any piped material!



this Catawissa Cup-Orifice Plate CONVERTS any standard Catawissa Union into a *GASKETLESS* ORIFICE UNION



ELIMINATES the necessity of expensive gaskets...the uncertainty of what type gaskets are needed for specific temperature and pressure requirements... fumbling with extra parts!!!

Orifice Union problems of the past are gone forever! Stainless or carbon steel cup-orifice plate fits easily, quickly, securely to form a good, tight, leakproof seal. Temperature and pressure requirements are restricted only by the rating of the union itself (3000-lb. service, 9000-lb. test)!

Just specify "Catawissa Cup-Orifice Plates" or "Catawissa Cup-Orifice Unions" at your favorite supply store—or write for catalog and complete information.

CATAWISSA VALVE & FITTINGS CO.
CATAWISSA • PENNSYLVANIA

Look at the record

BROWN BOVERI

Year after year BROWN BOVERI has opened new vistas in extra-high voltage equipment and applications. Today BROWN BOVERI can point to 2,450,000 KVA in EHV transformer capacity delivered or on order. More than 133 air-blast circuit breakers rated 300 KV and above have been in successful operation for years both in North America and Europe.

A record of world-wide confidence in BROWN BOVERI EHV transformers and air-blast circuit breakers has been established through actual use and top performance. Maximum design voltage of most of this transmission equipment is 460 KV. Pioneering research and development of transformers and air-blast breakers rated up to 650 KV is in progress at BROWN BOVERI.

In your system planning, it may pay you to consider BROWN BOVERI'S unmatched background in the field of extra high voltage.

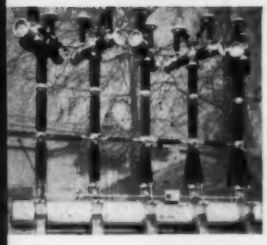
The complete record is yours for the asking.

EHV TRANSFORMERS

Client and Shipping Date	KVA and Voltage Rating
Krangede AB Sweden 1956	two banks 130 MVA each, 13.8/400 kV step-up generator transformers
Kraftwerke Hinterrhein Switzerland 1957	two banks 400/280/187 MVA 420/201/10 kV *regulating* auto-transformers
RWE Germany 1958	one bank 660 MVA, 400/230/30 kV *regulating* auto-transformers
EDF France 1958	one bank 300 MVA, 380/230/10 kV
Imatran Voima Oy Helsinki, Finland 1960	four single-phase three-winding auto-transformers, three-phase bank rating 420/420/55 MVA, 380/238/20 kV

EHV AIRBLAST CIRCUIT BREAKERS

Client and Date of Order	Quantity	MVA & Voltage Rating	
KVS Sweden 1951	10	10000	400 kV
Kamijoki Finland 1955	2	10000	380 kV
Quebec Hydro 1954	23	10000	300 kV
Imatran Voima Oy Finland 1956	2	10000	380 kV
Quebec Hydro 1956	39	10000	300 kV
Imatran Voima Oy Finland 1957	5	10000	300 kV
Imatran Voima Oy Finland 1957	1	15000	400 kV
American Electric Corp. 1957	2	25000	345 kV
RWE Germany 1957	2	15000	400 kV
Aluminium Co. Canada 1957	4	15000	300 kV
Krangede AB Sweden 1957	2	15000	400 kV
Aluminium Co. Canada 1957	5	10000	345 kV
Aluminium Co. Canada 1957	4	10000	345 kV
Aluminium Co. Canada 1957	5	10000	345 kV
Motor Columbus Switzerland 1957	2	15000	400 kV
Imatran Voima Oy Finland 1957	3	15000	400 kV
KW Vorderrhein Switzerland 1958	6	15000	400 kV
Kemiyoky Oy Finland 1958	1	15000	400 kV
Electricity Supply Commission South Africa 1959	16	15000	275 kV



BROWN BOVERI CORPORATION

19 Rector Street, New York 6, N. Y.

For more facts circle 295 on Reader Service card, p 121

Cut Perfect Gaskets *Easily* with the ALLPAX Gasket Cutter

If you can draw circles with a compass you can cut perfect gaskets in seconds with this handy kit. Just set the blade for the desired thickness, set the pivot post at the desired diameter, and a smooth swing of the cutter gives you a clean, accurate gasket . . . from a ¼ inch bolt hole to a 60 inch outside cut. Larger diameters can be cut with additional extension arms.

The ALLPAX Gasket Cutter is packaged in this strong steel case.

The ALLPAX Gasket Cutter has become standard equipment in thousands of plants where expensive "down time" is kept at a minimum by cutting new gaskets when and where they are needed. Available in five styles to cut maximum diameters of 12, 24, 36, 48, 60 inches.

Use the following Allpax gasket materials for your gasket requirements:

- 400 —Compressed Asbestos Sheet
- 500 —Superheat Compressed Asbestos Sheet
- 600 —Vegetable Fiber Oil Proof Sheet
- 700 —Red Rubber Sheet
- 750 —Black Rubber Sheet
- 800 —Diaphragm Sheet
- 850 —Cloth-Inserted Sheet

ALLPAX

"The Packing that Packs All"

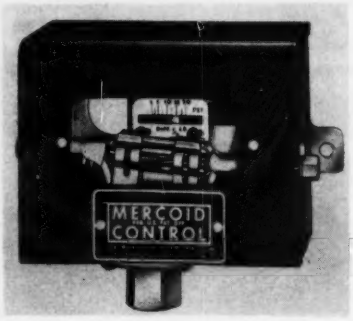
SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials
Distributors in principal cities

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

and 250-v dc, with interrupting capacities rated at up to 10,000-amp rms, maker states.

Compact units see service with limited-duty motor starters, automatic lighting controls, remote-control main service switchs, heavy-duty contactors. Automatic or manual reset is available.—Lake Shore Electric Corporation

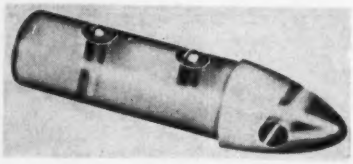


Pressure control

23 • Recommended for air or gas applications, pressure control measures 4⅛x3⅛x2⅞ in., weighs only 1¾ lb. It's useful for limited-space applications — mounting on wiring channels, for example.

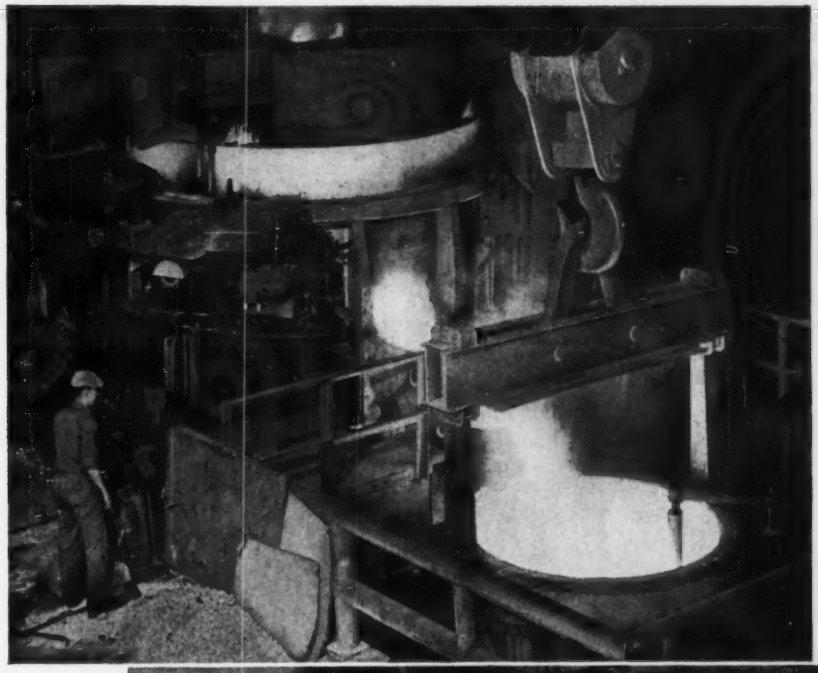
External adjustment, repetitive trip point, visible calibrated dial with pointer, visible hermetically sealed mercury contact are features. Operating range is 1 to 20 psig adjustable.—The Mercoid Corporation

Just circle key numbers on the Reader Service card, page 121, to get complete product story



Plastic tube pilots

39 • Light, easy-to-handle units are used with heat-exchanger and boiler tubes from ⅜- to 1-in. OD. They speed assembly of tubular equipment by piloting tubes through tube sheets, baffles and support plates. This pro-



Tapping a 50-ton arc furnace at B&W Barberton works.

Rigid quality control is maintained through all phases of production down to final inspection.

Why B&W Hollow Forged Piping Gives Long, Dependable Service

At B&W, quality control of Hollow Forgings is constant from initial melt to final inspection of the finished product. This *integrated* control is a big reason why B&W Hollow Forged Piping is the most practical choice for main steam, reheater, feedwater, and other heavy-duty high-pressure or high-temperature lines.

Testing at B&W includes analysis and grain structure examinations—hydrostatic test—and ultrasonic test as standard procedure. What's more, B&W machines the outside surface of every forging, to assure good appearance and ease of fabrication.

B&W Hollow Forged Piping is available in a wide range of sizes, in carbon, alloy and stainless grades, and is made to ASTM specifications. There is a size and grade close to your optimum design requirements. For more about how B&W Hollow Forgings meet your needs best, write for Bulletin S-16. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

S-475-HF

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

For more facts circle 297 on Reader Service card, p 121

IT'S *what's behind*
THE BALL THAT COUNTS!

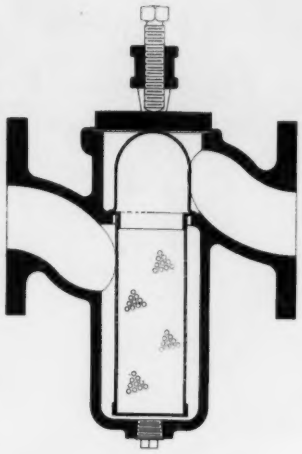
...and Bituminous, too!

BEHIND BITUMINOUS is unlimited supply and ever increasing technology of utilization. *No other usable power source is backed by both these important characteristics.*

You can base your constant power-fuel needs on bituminous with confidence—B&O Bituminous, of course! ***Ask our man!***

BALTIMORE & OHIO RAILROAD, BALTIMORE 1, MD., PHONE: LEXINGTON 9-0400

tects the ends, and you don't have to fish for tubes through misaligned tube holes.—Thomas C Wilson, Inc



Pipeline strainers

29 • Single-basket strainers feature minimum flow resistance, simplicity, quick cleaning and economy.

Sizes from two to six inches, all with flanged connections, are rated 125-psig working pressure (cold). Bodies and covers are cast iron.

Standard basket construction is stainless-steel plate with 1/8-in. perforations. For fine screening baskets are lined with stainless steel screens and baskets themselves have 1/4-in. holes, states maker. Schutte and Koerting Company

Just circle key numbers on the Reader Service card, page 121, to get complete product story

Chemical feeder

32 • This new system provides continuous automatic proportioning of liquid chemicals to treat cooling-tower water for corrosion, scale prevention. Feeder eliminates daily chemical charging, supplying from 1/10 to 1 gal of specially filtered liquid chemical every 24 hr.

Control is easily set and regulated, according to manufacturer. Heart of equipment is an aspirator type chemical feeder. A differential pressure regulator maintains a constant pres-

84,000 Hours of Reliable Viewing

. . . that is the Story of Dependability Behind Diamond's Television Camera Tube

Nor is the Story Finished. The ORIGINAL TUBE, installed in 1949, is Still in DAILY OPERATION!

At the Wood River Station of the Illinois Power Company, Diamond's "Utiliscope" Television system has provided 100% available viewing since 1949. In this job, dependability is all important! Only Diamond builds the tube which makes this availability possible.

The operator, in the control room, sees the boiler water level at the drum by viewing the Diamond monitor mounted in the control panel. Water level information is instantly and accurately available at all times from any viewing position in the control room.

Routine maintenance is the only service required since installation. "Old Reliable" has a record of more than ten years of operation and is continuing to provide reliable service.

Such performance is not unusual for Diamond's "Utiliscope" equipment. This Heavy Duty Television is designed for industry. It is dependable, durable, resistant to time and difficult operating conditions. It is saving money and improving operation in power plants, steel mills, foundries, mines and a wide variety of manufacturing plants.

Write us for a non-obligating survey of your plant by our industrial television specialists. Electronics Division, Diamond Power Specialty Corporation, Lancaster, Ohio.

8310

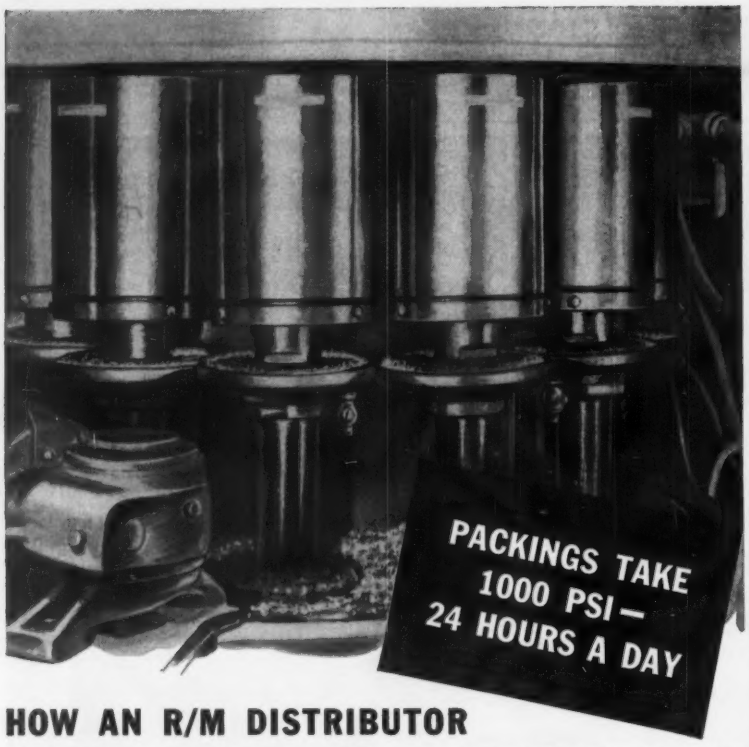
Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO *Diamond Specialty Limited, Windsor, Ontario*

For more facts circle 299 on Reader Service card, p 121

A mechanical packing problem . . .



HOW AN R/M DISTRIBUTOR STOPPED REJECTS AND SHUTDOWNS ON AN AUTOMATIC MOLDING MACHINE

To avoid rejects and shutdowns, a large manufacturer came to R/M for advice on this automatic rotary molding machine. A packing was needed that would control leakage of hydraulic fluid into the mold with resulting shutdown. R/M Vee-Flex® Packing Rings, one of the Big 7 Packing Types, were recommended and proved to be the answer. Since then the machine has been operating daily for 3 years under a pressure of 1000 psi and at approximately 200°F without need of repacking.

The solution to your own packing problems is as handy as your telephone. The R/M distributor near you has a wide range of experience that is yours for the asking. Remember, too, the R/M Big 7 packing family is carefully engineered for your specific job. Write for your distributor's name and address today.

THE BIG 7 PACKING TYPES

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

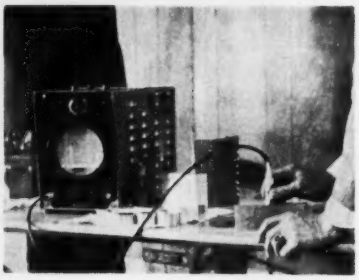
BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Equipment news

Begins on page 140

sure drop across a porous stone that acts as a rate valve. Flow rate through stone depends on depth of immersion —a pushbutton controls reagent level. Unit works with 10- to 400-ton cooling towers, using about 1 lb liquid chemical a day per 10 tons of air conditioning.—The Bird-Archer Co

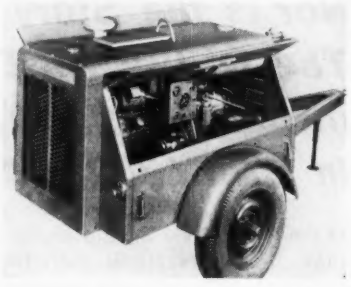


Ultrasonic flaw detector

12 • Test instrument offers simplified operation, convenient size and weight for field testing, but is flexible enough for lab use. Bright oscilloscope trace is visible under normal shop-lighting conditions.

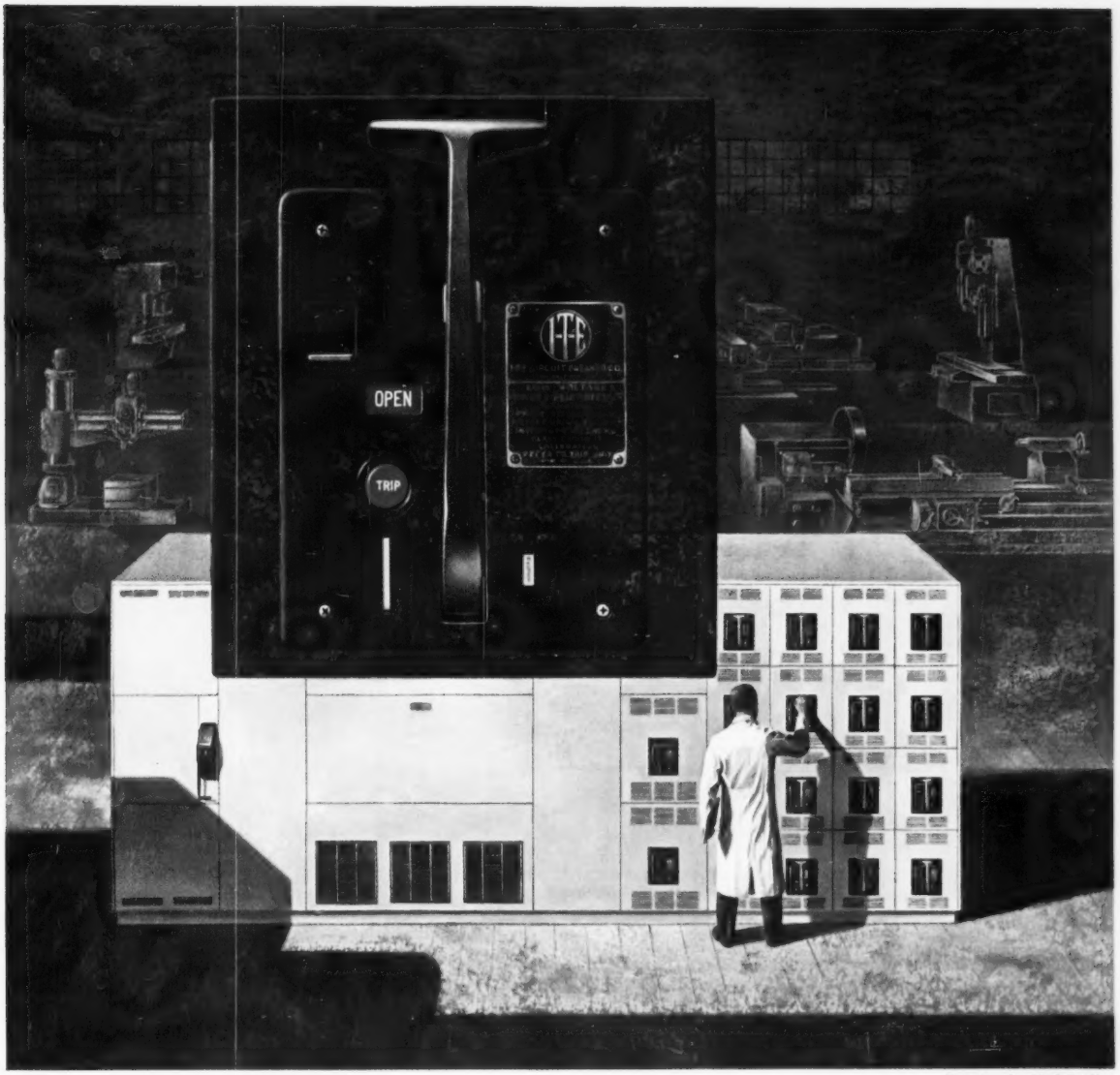
Flaw detection and thickness measurement are possible with Sonoray Model 5, using the pulse-echo principle. Unit is good for contact or immersian work. It costs $2750.00.—Branson Instruments, Inc

Just circle key numbers on the Reader Service card, page 121, to get complete product story



Single-stage compressor

45 • Low engine speed means that this portable rotary compressor is economical to operate and maintain. Unit combines single-stage simplicity with 2-stage economy—engine and compressor reach peak efficiency at 1800 rpm. This low-speed operation also reduces wear, and a clutch per-



Painting by Ned Seidler

FACT

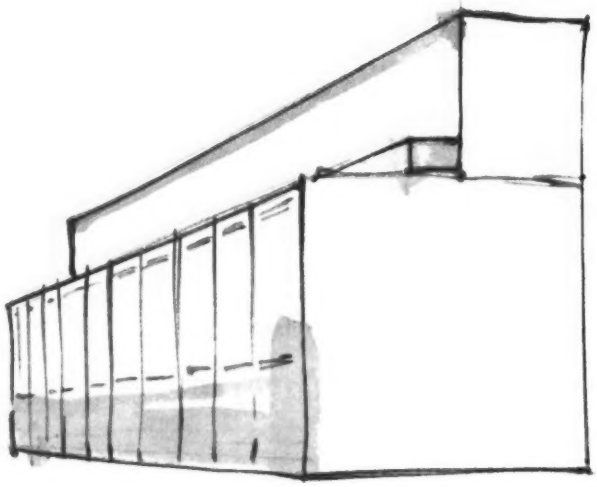
A dollar allocated for electrical equipment is worth more . . . when it is used to buy I-T-E equipment. Because I-T-E's policy is to build its equipment better, and yet charge no more.

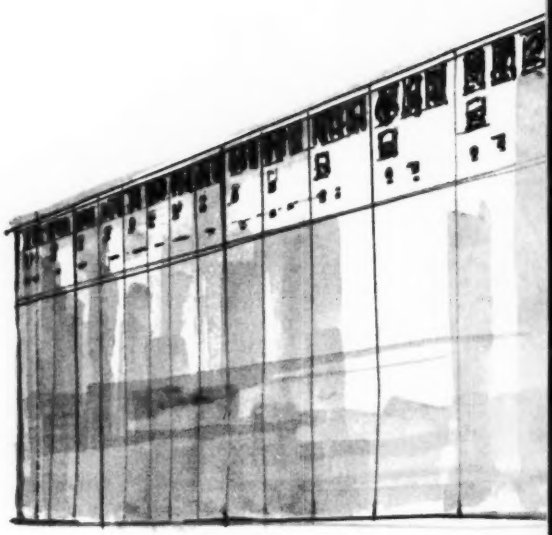
Take a typical secondary unit substation, for example. It features the new K-LINE circuit breakers . . . today's most advanced line. They stack four high in ratings up to 600 amp . . . save roughly ⅓ the space and half the weight formerly required. Circuit breaker pulldown handle with stored energy mechanism gives quick-make closure that means greater operator safety and longer contact life. The breaker can be drawn out to disconnect position without opening the door. And if the load increases later, expanded range trip devices adjust quickly and without added expense.

These features add up to real dollars and cents savings over the life of the equipment. Yet they cost nothing extra. In addition, I-T-E substations are engineered and manufactured in a single I-T-E plant for extra installation ease and better performance.

There are other I-T-E facts too. Turn page.

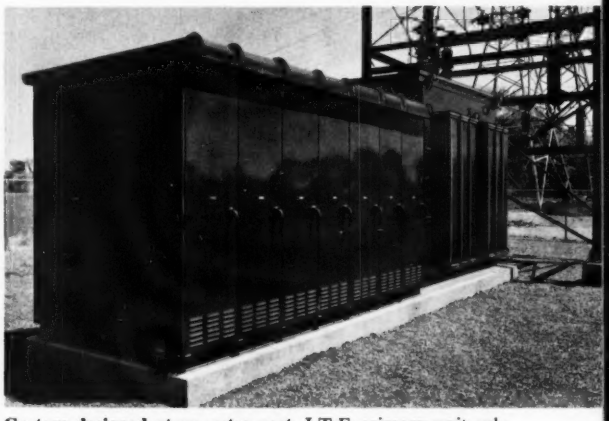
I-T-E CIRCUIT BREAKER COMPANY





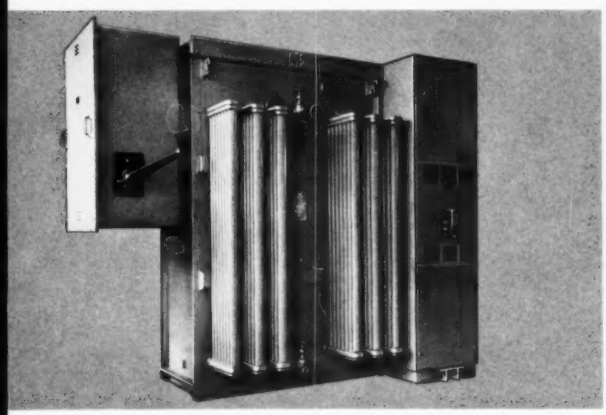
WHERE ELECTRICITY GOES I-T-E GOES

Are you fully acquainted with the broad I-T-E line . . . and the many ways it can help your dollars buy more?



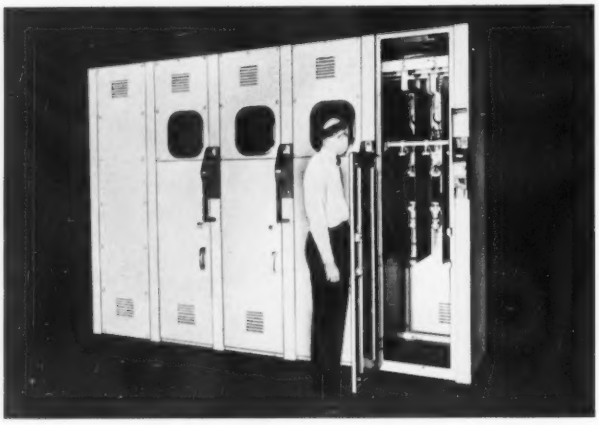
Custom designed at no extra cost. I-T-E primary unit substations are designed and built to meet the specified power, space and future expansion requirements of the particular installation for which they're ordered. In addition to standard outdoor metal-clad construction, weatherproof walk-in switchgear is also available. Transformer and switchgear sections are constructed in the same plant to assure smooth coordination of components, easier assembly, pretested performance, and on-time delivery.

Protection for primary power. I-T-E metal-clad switchgear has many extra advantages not available elsewhere. Take a good close look. You'll find extra sturdiness that means extra serviceability. And extra craftsmanship that gives the owner a feeling of pride. For easy inspection, even the rear doors are hinged, and components are completely accessible. All essential circuit breaker components are mounted on the breaker for easier access. Uniform flux density magnetic arc field means superior protection . . . especially against high current faults. For extra safety, breakers stop automatically in test position when they're rolled into the compartments. They can't be moved into or out of connected position unless they're open.

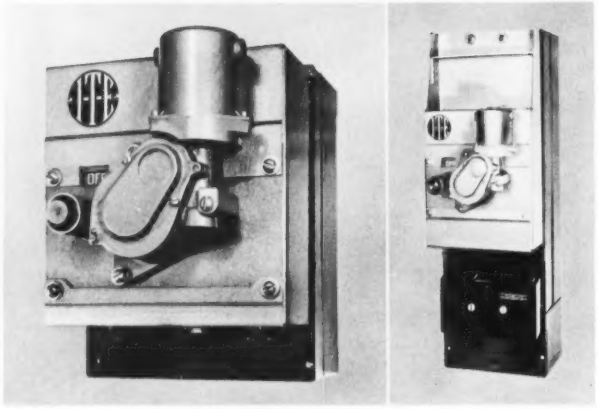


Self-contained substation. Saves installation cost. I-T-E TRANFO-UNIT combines primary disconnect, transformer and secondary circuit breakers all in one package. Nothing else to buy. Simplifies ordering. Delivered complete. Installation time and cost reduced to an absolute minimum. No complicated assembly of separate parts. Gives neat appearance. Completely safe. No live components open to contact by personnel. Needs no fence. Use for incoming power up to 3000 kva. Or spot near load areas in large plants.

600 volt value package. New URELITE® individually enclosed I-T-E K-LINE circuit breaker is ideal for single circuit protection and control, such as large motors and other heavy loads or for service entrance on many commercial-type buildings. Main disconnect contacts are visible through a side window for extra safety. Features quick-make closure, closed door disconnect, and expanded range trip device. Available in capacities from 15 to 1600 amp continuous, up to 75,000 amp interrupting.



Economical primary switching. I-T-E power switching centers save cost and time. Give dependable fused protection at low initial investment. Building block design speeds delivery. Preassembled units easy to install. Performance-proved I-T-E switches close safely into fault. Available for remote or automatic control. Up to 14.4 kv and 1200 amp.



Molded case economy . . . remote control luxury. Now I-T-E CORDON® circuit breakers are available with new TELEMAND* motor-operators for remote opening, closing or resetting. Gives pushbutton control from a distance. Permits automatic operation. CORDON circuit breakers provide up to 100,000 amp interrupting capacity in roughly half the switchboard space required by alternative devices. They cost approximately ⅓ less. TELEMAND is available for the complete range of molded case circuit breakers from 70 to 800 amp.

**Telemand is an I-T-E trademark*

I-T-E Circuit Breaker Company C-63A

1900 Hamilton St., Philadelphia 30, Pa.

- ☐ Secondary unit substations
- ☐ Metal-clad switchgear (4.16 and 13.8 kv)
- ☐ Primary unit substations
- ☐ URELITE circuit breakers
- ☐ Molded case circuit breakers
- ☐ Metal-enclosed bus
- ☐ Outdoor air switches
- ☐ TRANFO-UNITS
- ☐ Power switching centers
- ☐ TELEMAND (motor-operated molded circuit breakers)
- ☐ K-LINE LV switchgear (600 volt)
- ☐ Reclosers
- ☐ Distribution cutouts
- ☐ Other.....

Name.....Title.....

Company.....

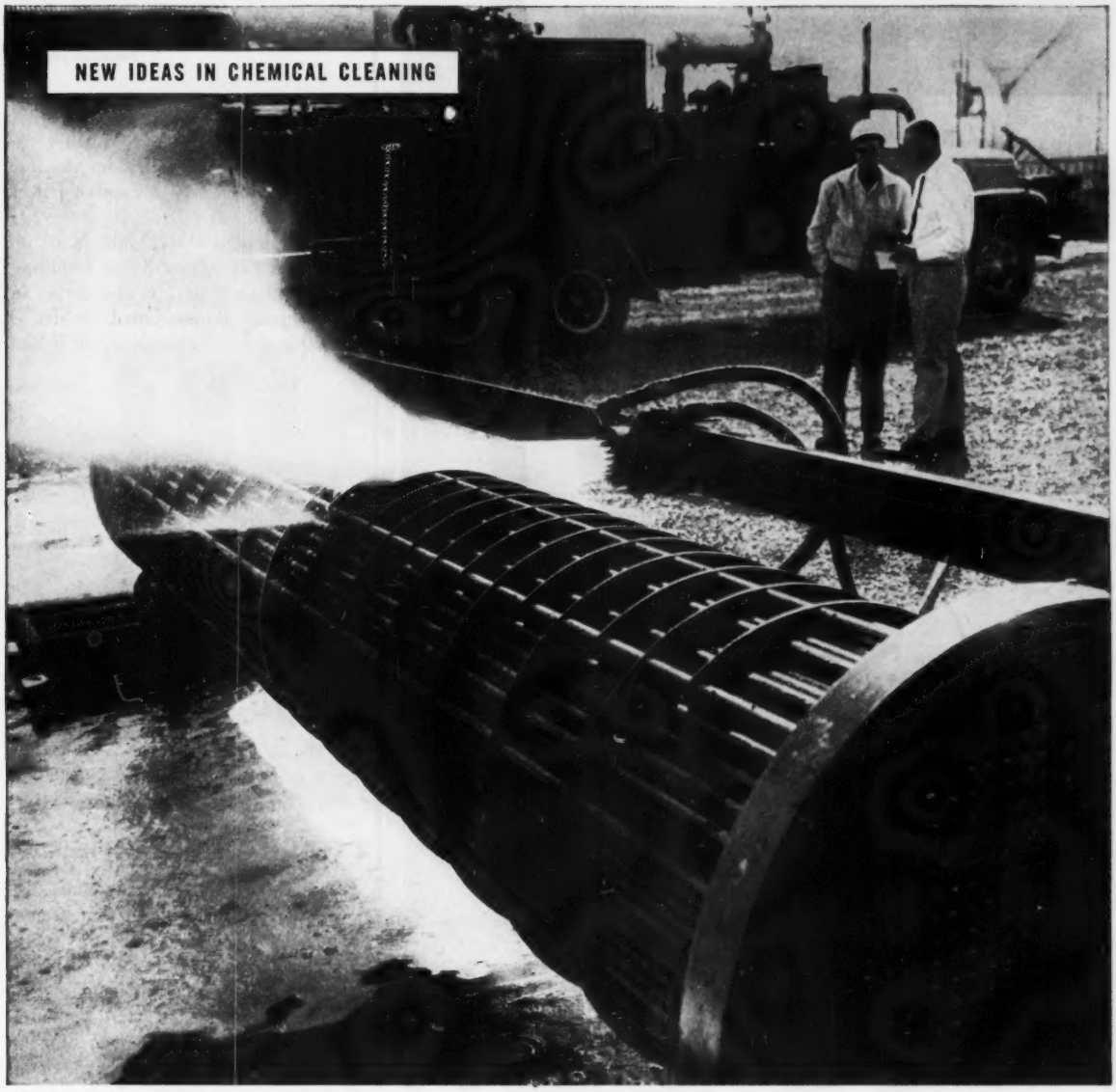
Street.....

City.....Zone.....State.....

SEND COUPON

Get complete, up-to-date information on I-T-E equipment.

I-T-E CIRCUIT BREAKER COMPANY



New Jetting Tool To Clean Tube Bundles Saves Thousands Of Dollars

The new high-pressure hydraulic tool, shown above, is currently saving thousands of dollars for companies in the refining, chemical, and petrochemical industries. It is the jetting tool developed by Dowell to remove deposits from heat exchanger tube bundles.

Previous methods of cleaning these bundles have been costly, time-consuming and often inadequate. Many times bundles had to be replaced completely because of the lack of a suitable cleaning method.

This new Dowell tool has a remarkable record of thorough, fast cleaning. For example, a slurry reboiler exchanger bundle, three feet in diameter and 16 feet long, was fouled with deposits of coke and asphalt. After being jetted from only one side, the bundle was thoroughly clean. Time required: less than one hour.

The tool holds the bundle in place for cleaning and has flanged rollers for rotation. The jet-head is manipulated automatically so that all tube spaces are covered. The jetted liquid can be either water or chemical solvents.

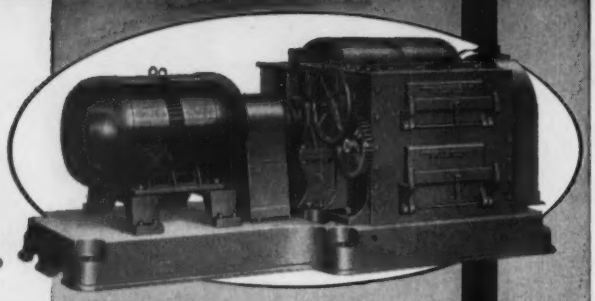
This high-velocity jetting device is another example of the new ideas Dowell continues to offer in chemical cleaning to help you cut your costs. Whatever the cleaning problem in your plant, call Dowell for an engineered recommendation. Dowell — the largest, the oldest, the most experienced chemical cleaning service — Tulsa 1, Oklahoma; and 165 stations and offices in major industrial centers.

Chemical cleaning service for all industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

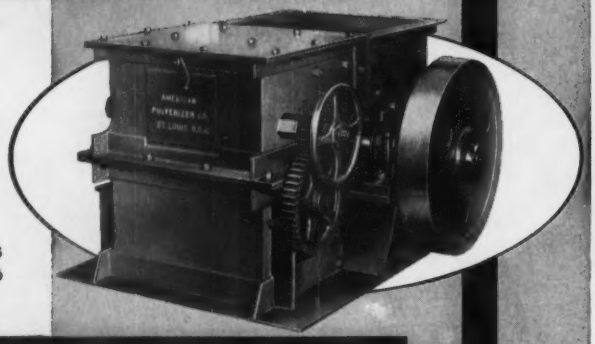
For more facts circle 302 on Reader Service card, p 121

When You Figure . . .



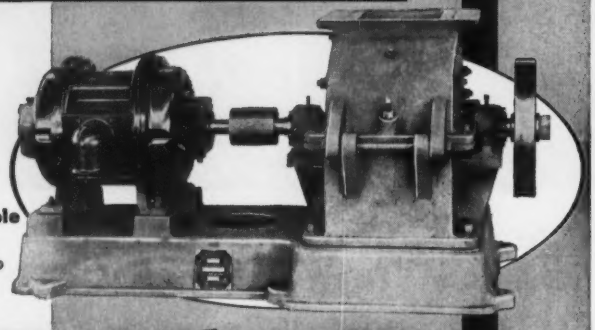
AC Series
capacities to
800 TPH

Reduction
Cost Per Ton . . .



WC Series
capacities to
90 TPH

the Best Answers*. . .



Coal Sample
Crushers
capacities to
2000 Lbs.
Per Hr.

Come from American
Ring Coal Crushers

*In a recent independent survey, it was found that American Crushers reduced over 61,000,000 tons of coal at a parts replacement cost (including standby parts) of *less than 1/10th of 1¢ per ton.*

THERE CAN BE NO BETTER PROOF OF AMERICAN QUALITY!

American
PULVERIZER COMPANY

WRITE for Literature on These Crushers

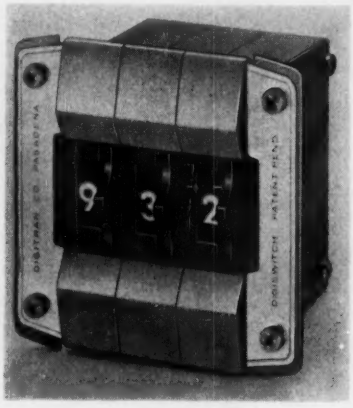
1349 MACKLIND AVE. • ST. LOUIS 10, MO.

Equipment news

Begins on page 140

mits no-load warmup to further extend engine life. The 168-hp gasoline engine has over 50% reserve power capacity, maker states.

Unit stands 54-in. high, is 61-in. wide and 121 9/16-in. long including heavy-duty tow bar. It also comes in a compact skid-mounted model.—Worthington Corporation, Holyoke Div



Modular in-line switch

40 • Panel space requirements are reduced with this unit, so that twenty switches can be mounted in space normally required for five conventional rotary switch elements.

Finger-controlled switch provides for ten-position single-pole binary-coded decimal 1, 2, 4, 8 and Octal 0, 1, 2, 4 coded outputs. In-line readout is said to reduce reading errors, simplify setting. Switch-module design permits ganging.—Digitran Co

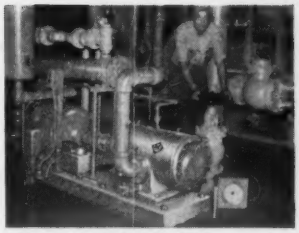
Just circle key numbers on the Reader Service card, page 121, to get complete product story

Acceleration switches

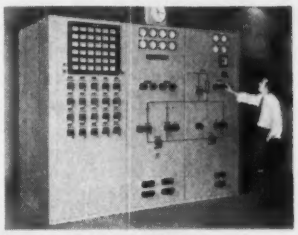
26 • Precision-ground steel ball is held against a solid base by a uniform magnetic field. When opposing force of acceleration exceeds magnetic force, ball moves to make or break electrical contact. Three basic designs are axial, radial and omnidirectional types. Units are available for momentary or latching action. Momentary models automatically re-

In pace with POWER... **ALLIS-CHALMERS**

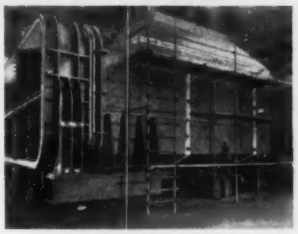
ALLIS-CHALMERS



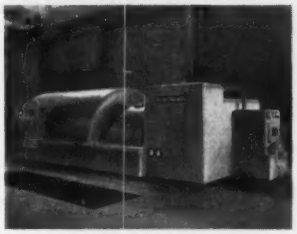
COMPRESSORS



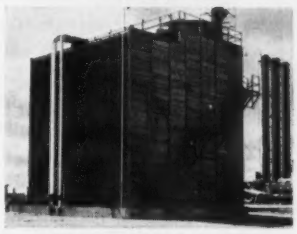
SWITCHGEAR



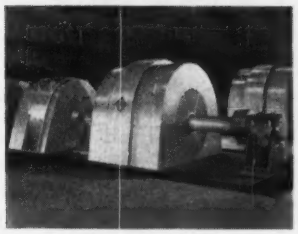
CONDENSERS



STEAM TURBINES



WATER CONDITIONING



MOTOR-GENERATOR SETS

Coordinator for a talent task force...

...he's your Allis-Chalmers man

This task force of experts bulwarks the Allis-Chalmers man. Their purpose: To offer comprehensive, single-source services to help you with preliminary power system planning, erection and operation.

Call the A-C man in *early* ... to put these researchers, engineers, field service men and other specialists to work on your next power project. He'll make recommendations ... coordinate schedules of individual products to entire power systems. And you get all the benefits of Allis-Chalmers parts and service programs.

On the following pages, you'll see a few of the power products offered. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-1170-PR

ALLIS-CHALMERS

MOST COMPLETE LINE

Eleven Product Groups Serve Every Sealing Need

GROUP NO. 4

Criss-Cross Braided Packings

A revolutionary Braided construction in which every strand passes diagonally *through* the body of the packing and becomes an integral part of the whole, making it stronger, longer wearing, better lubricated.

Belmont offers a wide variety of styles of Criss-Cross Braided Packings in long fibre Canadian asbestos, blue African asbestos, wire-inserted asbestos, flax, cotton, Teflon* yarn, Teflon ribbon and Teflon impregnated blue and white asbestos—for low, medium and high pressure service and temperatures to 700° F—sealing against steam, water, air, gases, oil, gasoline, alcohol, corrosive chemicals, and for positively non-contaminating service.

See your Belmont Distributor or write for the name of the one nearest you.

MOST CONVENIENTLY AVAILABLE

Nationwide Industrial Distributor Organization Provides On-the-Spot Service

OTHER BELMONT PRODUCT GROUPS

1. High Pressure Asbestos Packings
2. Valve Stem Packings
3. Rotary Pump Packings & Seals
5. Hydraulic Packings
6. Bel-Vee V-Rings
7. Sheet Packings
8. Gaskets
9. Metallic Packings
10. Plastic Packings
11. Expansion Joints

*du Pont Trademark

BELMONT

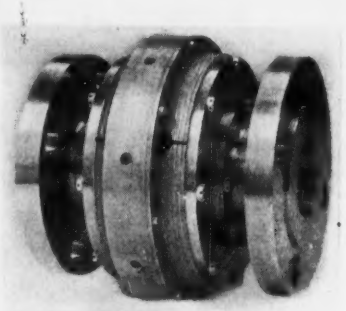
The Belmont Packing and Rubber Company • Butler & Sepviva Streets, Phila. 37, Pa.

Equipment news

Begins on page 140

set themselves, latch models are manually or electrically reset.

Magnetic field is said to be stable through temperature range of –65 to 250 F. Response time is less than 40 milliseconds. Units come factory-calibrated or can be calibrated by the user. Length is usually less than two in., diameter ¾ in. or less. Complete switches range upward from ½ oz. Applications include regulating excessive vibration in rotating machinery, and underspeed protection. —Inertia Switch, Inc



Leakproof valve

38 • Compact valve has no moving parts between fluid chamber and atmosphere, so it can safely handle radioactive and toxic fluids. There is negligible pressure drop across the closure disk. Unit is suitable for tight shutoff or automatic throttling of gases and liquids.

Internals can be made of any weldable corrosion-resistant material, externals of brass or steel. Working temperatures are –20 to 1500 F, pressures range from 0.005 microns vacuum to 150 psig in smaller sizes, to 30 psig in sizes up to 72-in. dia.—Singmaster & Breyer

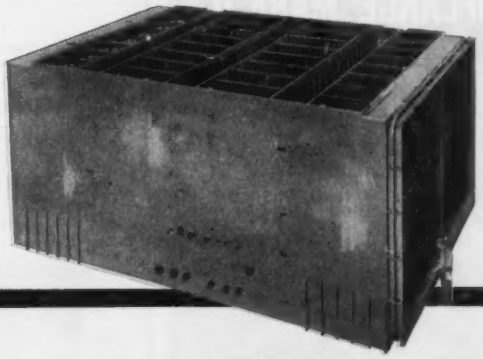
Just circle key numbers on the Reader Service card, page 121, to get complete product story

Silicone grease

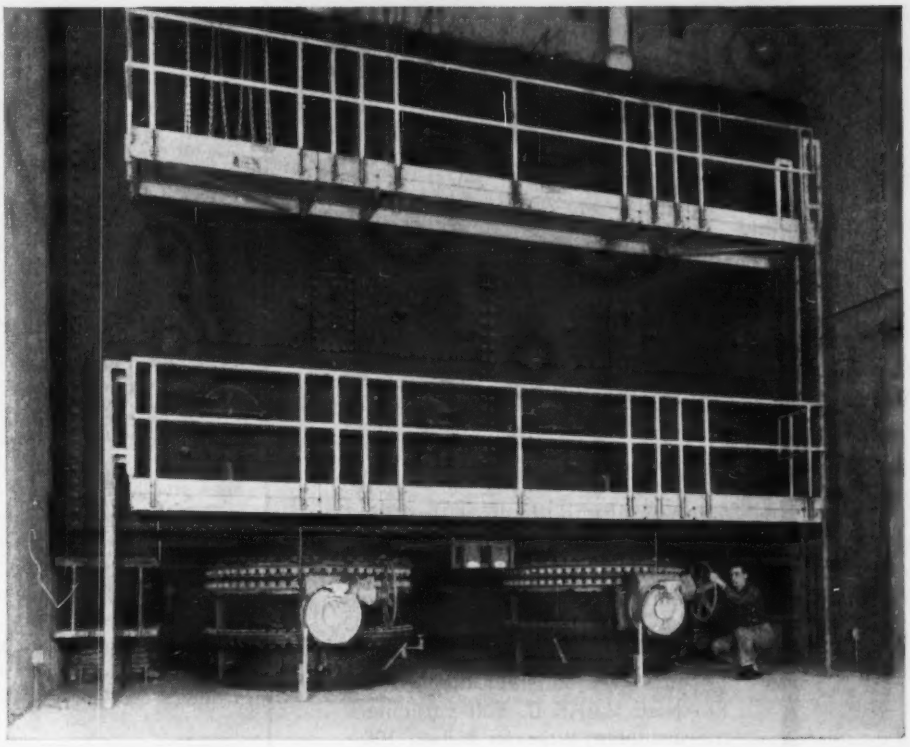
18 • Designed as a rust inhibitor and lube for mated, threaded or non-threaded ferrous components and fabricated rubber parts, product is known as *SS-4007*. It maintains its consistency from –75 to 300 F, sees service as a high and low-tempera-

ALLIS-CHALMERS

In pace with POWER... ALLIS-CHALMERS



Today's BIGGEST Condenser



200,000-square-foot condenser now in operation at Fisk Station of Commonwealth Edison

Some man-sized problems were presented by this unit... not the least of which were shipping and erection. Special Allis-Chalmers well-center cars permitted shipment of the entire shell in only four sections. Special alignment techniques developed by A-C cut installation time.

Today it serves a 327-mw Allis-Chalmers steam turbine generator. Note the compact, space saving rectangular shape pioneered by Allis-Chalmers and made practical by the A-C guided-flow condenser design.

For help on your condenser problems, large or small, contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-1046-PR

ALLIS-CHALMERS

For more facts circle 306 on Reader Service card, p 121

SIDEWINDER OPERATOR
totally enclosed, low friction, powerful

NYLON BEARINGS
low friction, long lasting

CHEVRON PACKING
never needs adjustment

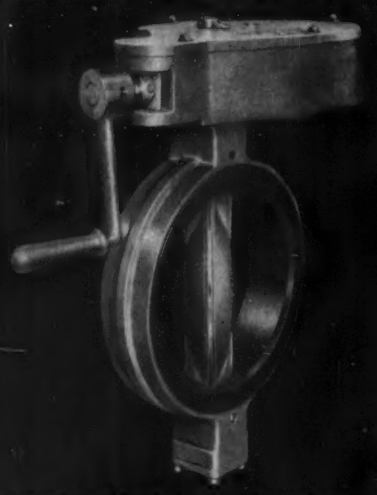
SHAFT
straight through, stainless steel or monel

DISC
one piece, cast in choice of materials

HYCAR SEAT
never needs replacement

BODY
cast iron or cast steel

the MONOFLANGE MARK II



the valve that industry demanded*

*The motivating force behind the creation of this, and other new products soon to be announced, was the obvious industry need for this type of equipment. Henry Pratt MARKET ORIENTED valves are all new for 1960.

Usually, the most significant contributions to industry stem from ideas born of experience. Such a contribution is the Pratt MONOFLANGE MARK II—a really different valve. The difference is in design and conception—for here is a valve designed to meet the ever increasing need for a compact and sensible 150# valve. Drop-tight and ideal for throttling service, the MONOFLANGE MARK II is a versatile valve. Even the manual and automatic operators are new—all enclosed, powerful, rugged, and reliable. For a high quality, reasonably priced valve, consider the MONOFLANGE MARK II. Full particulars are available. Write for Bulletin 10K.

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Monoflange MK-II
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Creative Engineering for Fluid Systems

HENRY PRATT COMPANY
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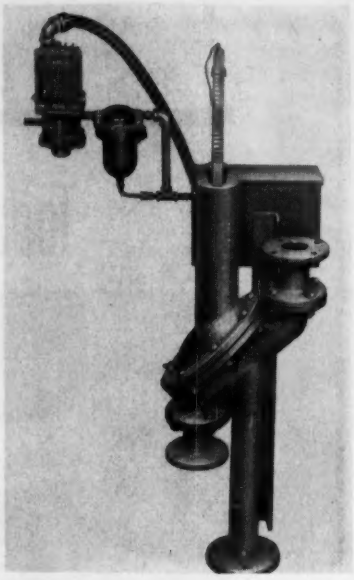
Representatives in Principal Cities

Equipment news

Begins on page 140

ture thread lube, a corrosion preventative compound, a lube for O rings. — General Electric Company, Silicone Products Dept



Controlled-volume pump

11 • Hard-to-handle slurries or solutions are no problem to this pump, maker states. Inclined pump chamber automatically eliminates entrained air from body, double-ball check assemblies give high metering accuracy.

Unit handles abrasive slurries with up to 60% solids, delivers them at pressures as high as 90 psi. Gentle diaphragm action cuts down particle regradation, and unit can pump against high discharge pressures to effectively handle feeds to all types of filters.—Milton Roy Company

Just circle key numbers on the Reader Service card, page 121, to get complete product story

Gas-turbine engine

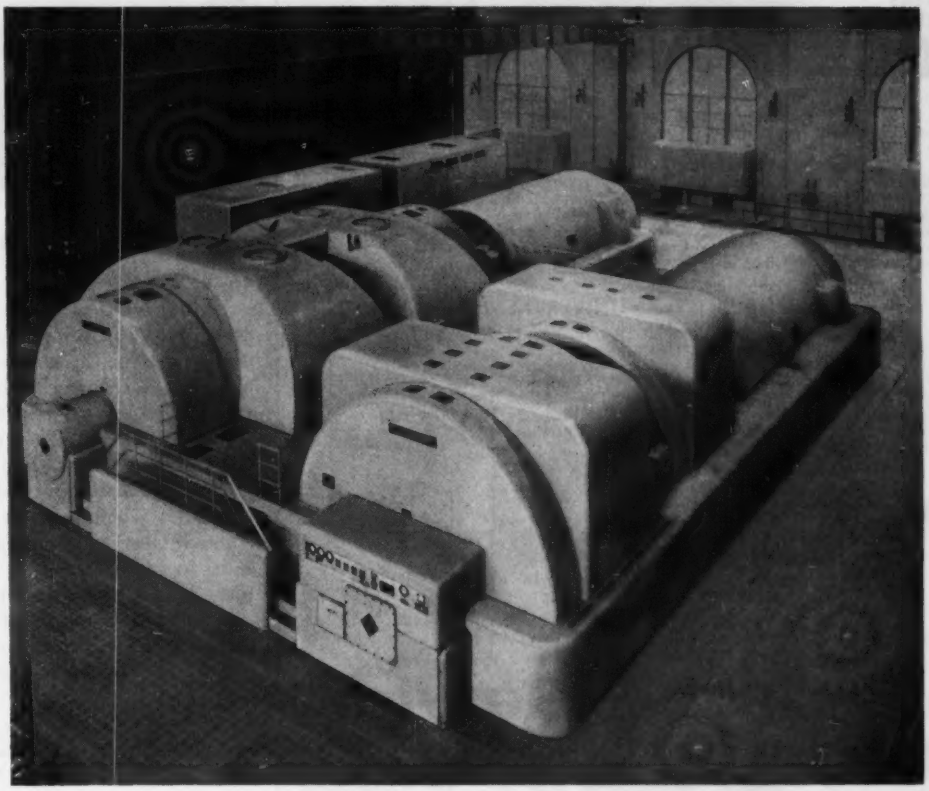
25 • New unit weighs 950 lb, produces 1250 hp. Simple-cycle specific fuel consumption is 0.60 lb per hr and thermal efficiency is 23%, according to maker.

Available in constant- and variable-speed models, the *Saturn* will serve as power source for generator sets, compressor and pump drives.—Solar Aircraft Company

continued

ALLIS-CHALMERS

In pace with POWER... ALLIS-CHALMERS



327-167-kw close-coupled, cross-compound 3600/1800-rpm unit — separate excitation m-g sets in cubicles, upper right. Steam conditions: 2000 psig, 1050 F at inlet, 1000 F reheat, 1 inch Hg absolute exhaust pressure.

Commonwealth Edison's new 327,167-kw Fisk 19 doubles station output

This steam turbine generator, the second of several such Allis-Chalmers units to go into service, is equipped with record 46-inch long exhaust blades. The unit's 200,000-sq-ft Allis-Chalmers condenser, too, is of world-record size.

Notable among today's generation achievements, Fisk 19 employs close-coupling with short crossunders, a ring-type nozzle chest, side-mounted turning gears, a double-flow intermediate pressure turbine and a fully supercharged 3600-rpm generator.

To learn more about these and other design features of Allis-Chalmers tandem and cross-compound units, see your nearby A-C office or write to Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Plan to stay ahead... MODERNIZE!

AC ALLIS-CHALMERS

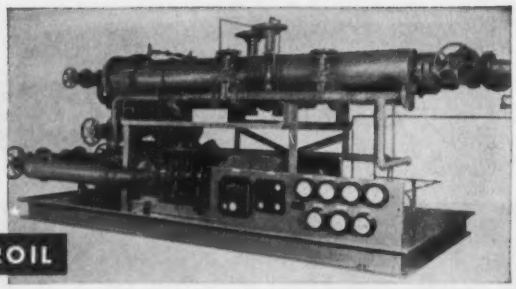
A-1154-PR

ALLIS-CHALMERS

Fuel Oil Pumping & Heating Units

FOR EVERY REQUIREMENT

NATIONAL AIROIL



We make a full line of Fuel Oil Pumping and Heating Units to prepare heavy fuel oil for combustion with all types of Oil Burners. Illustrated is a compact, space saving Unit of 50 g.p.m. burning rate — twin motor driven pumps and twin oil heaters built to A.S.M.E. Code. Control panel includes: Pilot Control Thermometer, Pressure Pilot Control, Gauges to indicate oil inlet to each heater, Temperature and Pressure Suction Vacuum, Oil outlet pressure from each Heater and main Steam Pressure to each Unit . . . Temperature and Pressure Control Valves are air actuated for quick response, and to hold discharge pressure and temperature within 1%, from minimum to maximum firing rate.

Send for Catalog No. 40 which gives standard sizes and capacities; special units built to order.

UNIVERSAL REGISTER UNITS

We make various types of Universal Register Units including the swing-type, as illustrated. The Unit illustrated can be furnished with Gas Burners, ring or cylinder type, and/or Oil Burners, for either natural or forced draft . . . All vanes are variable independently of each other, and reversible from left to right turbulence (or vise versa) as a Unit. Integral damper disc permits closing-off each individual burner tile to prevent air leakage on shut-down.

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Main Office & Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

For more facts circle 309 on Reader Service card, p 121

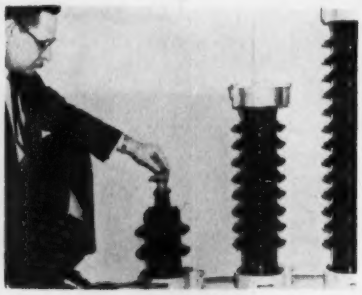
Boiler Tube Service

BOILER TUBE COMPANY OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

Equipment news

Begins on page 140

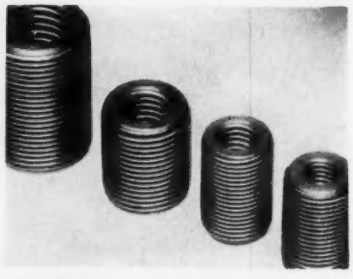


Lightning arresters

46 • Rated 3 to 121 kv, Type 1VS lightning arresters protect electric-distribution apparatus. Units feature low-discharge characteristics, low-impulse sparkover and high-surge capacity in excess of 100,000 amp, according to maker. They meet ASA, AIEE and NEMA standards.

Porcelain housing contains a high-strength glaze for greater cantilever strength. Deeper-dish porcelain skirts resist contamination. A side vent plate drops off when pressure-release diaphragm operates, to prevent excessive pressure buildup with 60-cycle current flow.—Westinghouse Electric Corporation

Just circle key numbers on the Reader Service card, page 121, to get complete product story



Bolster plate bushings

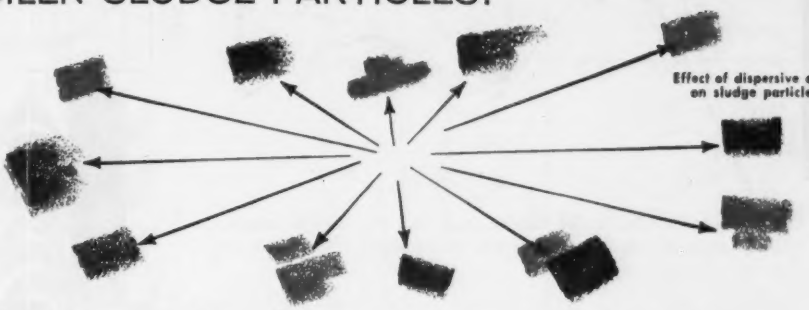
21 • These units cut repair time, eliminate problems of "pulled-out" cast-iron threads, reduce need for bulky threaded cast-iron sections. Just retap bolster plate hole, insert threaded bushing to match.

Bushings are tough heat-treated alloy steel. They're recommended for repairs; in original design applications for added strength.—Jergens Tool Specialty Company

ALLIS-CHALMERS

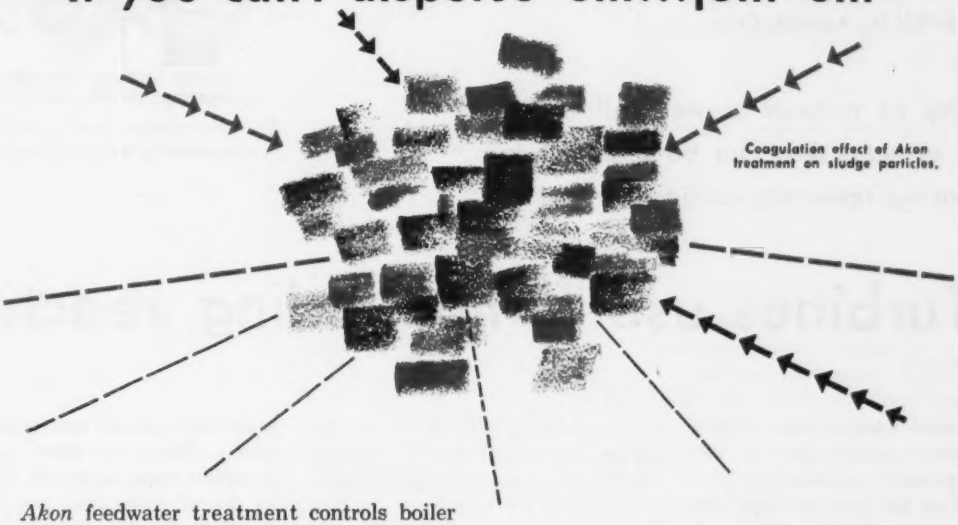
In pace with POWER... ALLIS-CHALMERS

BOILER SLUDGE PARTICLES:



Effect of dispersive agent on sludge particles.

If you can't disperse 'em...join 'em



Coagulation effect of *Akon* treatment on sludge particles.

Akon feedwater treatment controls boiler sludges where dispersive agents fail or lose their original effectiveness.

Coagulating action of *Akon* treatment takes sludge particles out of circulation by forming fluffy, *nonadherent* flocs. These flocs are readily discharged with less blowdown than otherwise required — save fuel, water and chemicals.

More advantages of this process: Eliminates dissolved oxygen by scavenging action to prevent corrosion; permits operation at lower alkalinities; reduces tendency for carryover with no decomposition products.

To cut your boiler operating costs and protect your equipment investment now and for years to come, specify Allis-Chalmers feedwater treatment.

Akon is an Allis-Chalmers trademark.

Bulletin 2887408 illustrates and describes *Akon* treatment. Bulletin 28X7731 provides correct procedures for boiler cycle blowdown.

Mail coupon below for helpful facts on *Akon* treatment and blowdown —

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Milwaukee 1, Wisconsin
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Please send me the bulletins I have checked below:
☐ 2887408 on Akon treatment
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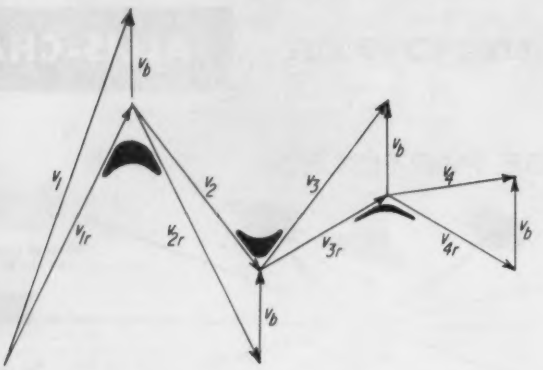
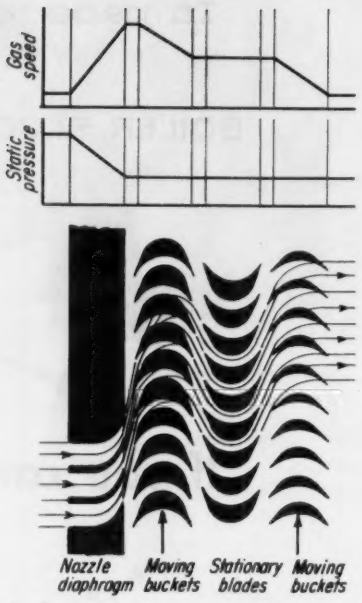
ALLIS-CHALMERS



1 Velocity-compounded turbine stage uses two rows of impulse buckets with intermediate row of stationary reversing blades



2 Static pressure stays constant in the three blading rows of compounded stage

By B G A SKROTZKI, Associate Editor

Flexibility of turbines shows itself in the variety of ways they can be designed to meet various operating conditions

Turbines use compounding, reaction

Last month we learned how to keep turbine wheel speeds down to safe levels by pressure compounding. Here we broke up the pressure drop into several steps in series to keep the jet speed, and so the bucket speed, down to the level needed.

Velocity compounding. Another method of getting reasonable bucket speeds with large pressure drop and high jet speed is velocity compounding. Fig. 1 shows the velocity diagram of this arrangement, Fig. 2 shows the physical layout. A set of nozzles produces a high-speed air jet at velocity v_1 that enters a first row of buckets, moving at v_b, with a relative velocity v_{1r}. Ideally the jet leaves the buckets at $v_{2r} = v_{1r}$. Directions of these two vectors fix the entering and leaving angles of the buckets.

Adding v_b to v_{2r} gives the absolute velocity v_2 of the leaving gas flow. The gas then enters between a set of stationary reversing blades to be redirected to a second row of moving buckets at ideal velocity $v_3 = v_2$.

Subtracting v_b from v_3 gives the relative entering velocity v_{3r} for the gas in the second row of buckets. Ideally $v_{4r} = v_{3r}$, the leaving relative velocity from the second-row buckets. Finally we add v_b to find v_4, the absolute gas velocity leaving the compound stage.

Graphs at top of Fig. 2 show that gas-flow speed rises in nozzles, drops in first-row moving buckets, stays constant in stationary blades and then drops again in second-row moving buckets. On the other hand, gas static pressure drops in the nozzles and stays essentially constant as it flows through the buckets and stationary reversing blades.

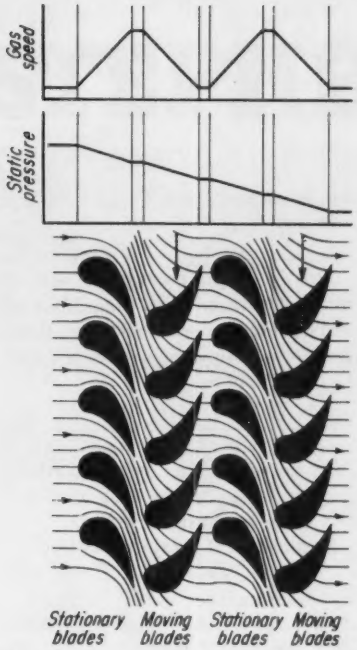
Efficiency of velocity compounding is lower than that of pressure compounding, as we can see by higher leaving velocity v_4. Frictional losses also run higher. But velocity compounding offers an advantage in taking a large pressure drop in one step and reducing the temperature at which the moving buckets run.

Reaction blading. We found that impulse turbines ideally have gas-pressure drops only in the stationary nozzles. When we direct gas flow through a nozzle as in Fig. 2, changing the direction and rate of flow, there is a strong reaction force acting on the nozzle diaphragm tending to turn it oppositely to the moving buckets. For this reason the turbine casing must be securely anchored to prevent overturning.

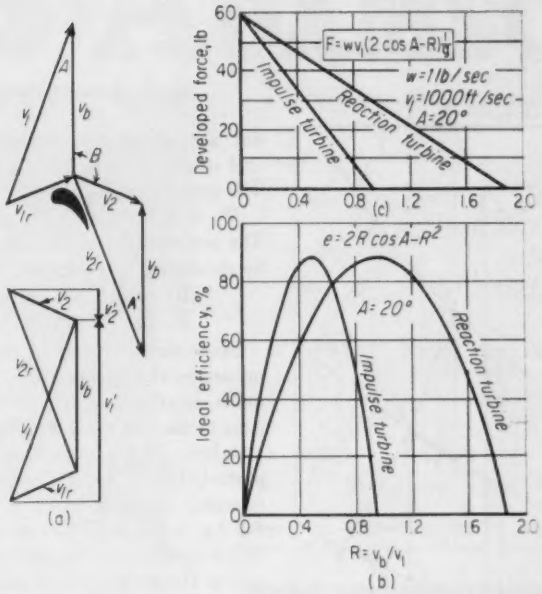
Reaction turbines put this force to work by allowing gas static pressure to drop in both moving blading and stationary blading (nozzles), Fig. 3. But the gas absolute velocity rises in the stationary blading and drops in the moving blades.

Fig. 4a shows the velocity diagrams of the gas. Gas leaves the stationary blading with speed v_1. By subtracting moving-blading speed v_b we find the relative entering velocity v_{1r} of the gas into the moving blading. But the moving blading turns the gas through an angle of almost 90 deg and because of the pressure drop accelerates the gas flow from v_{1r} to v_{2r}.

Subtracting blading speed v_b we



3 Gas pressure drops in both moving and stationary blading of reaction turbine



4 Reaction turbines have performance comparable with impulse turbines at different speed ratios; vectors are for 50% reaction

methods

find the absolute leaving velocity v_2 of the gas. Gas enters stationary blading of the following stage to be accelerated by a pressure drop to v_1 for that stage.

Blading cross section, Fig. 3 and 4a, has been developed by aerodynamic principles to give minimum losses. It works at good efficiency over a wide range of flow rates. Fig. 3 shows gas flow path by the stream lines; remember that the gas accelerates while it flows through the moving blades (relative to the blades).

Performance. We can run an analysis for the reaction turbine that parallels what we did last month for the impulse turbine. Assuming that the enthalpy drop through stationary blading equals that through moving blading we have $v_1 = v_{2r}$. Then from Fig. 4a, force acting on the moving blades is:

$$F = \frac{w}{g}(v'_1 - v'_2)$$

$$= \frac{w}{g}(v_1 \cos A - v_2 \cos B)$$

$$= \frac{w}{g}\left[v_1 \cos A - (v_{2r} \cos A - v_b) \right]$$

$$= \frac{w}{g}(2v_1 \cos A - v_b)$$

$$= \frac{w}{g}\, v_1\, (2 \cos A - R)$$

where $R = v_b/v_1$.

Power developed by the blading is:

$$P = F v_b = \frac{w v_1 v_b}{g}(2 \cos A - R)$$

Ideal blading efficiency is:

$$BE = \frac{P}{(w/2g)\ (v_1^2 + v_{2r}^2)}$$

$$= 2R \cos A - R^2$$

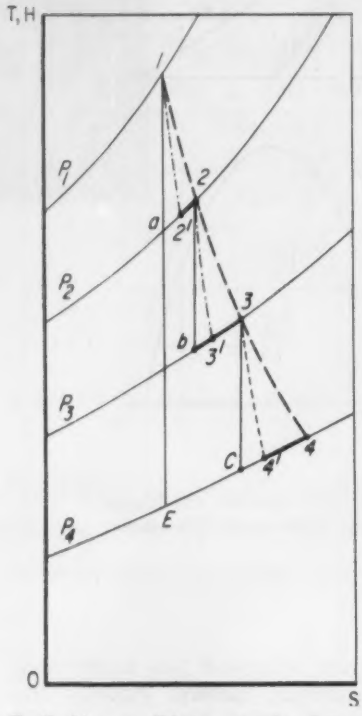
Fig. 4c shows how F varies with R for $w = 1$ lb per sec, $v_1 = 1000$ ft per sec and $A = 20$ deg, for both an impulse and reaction turbine. Both types develop the same force at locked rotor conditions. Force drops to zero at twice the blade-jet speed ratio for the reaction turbine.

Fig. 4b compares blade efficiency for impulse and reaction turbines for the given conditions. Maximum efficiency develops at slightly less than 1.0 speed ratio for the reaction turbine, just twice that for the impulse turbine. Developed forces for both turbines are equal at their maximum blade efficiencies as shown in Fig. 4c. Force at maximum efficiency for both units is one-half locked-rotor force.

Design factors. Pressure drop across moving blades in a reaction turbine makes some of the air leak between blade tips and casing. This clearance must be kept small, usually with the aid of thin sealing strips that wear quickly on accidental contact. Keeping pressure drop per stage small helps minimize the leakage. This means more stages per turbine, about double those needed for a pressure-compounded impulse turbine.

In an impulse turbine, nozzles may occupy only part of the total periphery of the nozzle diaphragm. Gas jet then works on only part of the total number of buckets on a wheel at a time. Since gas pressure on inlet and outlet sides of buckets is constant and equal jet has no tendency to break up.

In a reaction turbine, however, unequal pressure on inlet and outlet sides of moving blading makes an open path for gas flow through all the blading passages. If nozzles produced a jet of gas over only part of the periphery, the jet would quickly break up in seeking to flow through all the blade passages, at great loss in efficiency. Because of this, reaction turbines must have nozzles (stationary blading) around the full peri-



5 Turbine condition curve for 3-stage unit shows the changing state of gas

phery of all stages. That is, all stages must flow full of gas to maintain good blading efficiency.

Condition line. The steady-flow equation for a gas turbine, Part 23, January 1959, p 130, showed that the work output was:

$$W_2 = H_1 - H_2 + \frac{w}{2gJ}(v_1^2 - v_2^2)$$

If the entering and leaving velocities of the gas are relatively small, this boils down to simply:

$$W_2 = H_1 - H_2$$

Let's examine the process on a T-S or H-S diagram. Diagrams are exactly proportional for a perfect gas since $\Delta T = c_p \Delta H$. In Fig. 5, if an impulse turbine received gas at P_1 and expanded it at constant entropy from state *1* the gas would leave at state *E* at the exhaust pressure P_4. The ideal work done by the gas would then be:

$$W_2 = H_1 - H_E$$

An actual turbine, however, cannot use all of the available energy and would exhaust the gas at state *4*. The actual work is then:

$$W_2 = H_1 - H_4$$

The performance of the turbine would be measured by its engine efficiency:

$$e_e = \frac{H_1 - H_4}{H_1 - H_E}$$

Since we have studied the internal processes of a turbine we can make a more detailed analysis of what happens to the gas when flowing through a turbine. In Fig. 5 we have the states plotted for a 3-stage pressure-compounded impulse turbine. The line *1-2-3-4* is the *condition curve* or *line* of the turbine, and shows state of the gas at the three sets of nozzle inlets and exhausts. But the condition line is a trend line; a more detailed analysis shows that process *1-2'* is the gas expansion through the first-stage nozzles from P_1 to P_2. An ideal nozzle would expand the gas at constant S from *1* to *a*. The difference $H_1 - H_2' = KE$, kinetic energy of the gas jet leaving the nozzle, at pressure P_2. Nozzle efficiency is then:

$$e_n = \frac{H_1 - H_2'}{H_1 - H_a}$$

Process *2'* to *2* shows an increase in entropy and enthalpy as gas flows through the buckets, giving up most of its kinetic energy as it works on the buckets to develop mechanical work *W*. The enthalpy increase comes from part of the jet *KE* being lost in friction and turbulence and staying in the gas as internal energy. Stage efficiency is then:

$$e_s = \frac{H_1 - H_2}{H_1 - H_a}$$

Each of the following stages has similar processes plotted in Fig. 5 for nozzle and bucket flows, friction and turbulence losses being returned as internal energy to the gas. This reconversion of energy is called *reheat*. It has an advantageous effect in raising the overall turbine-engine efficiency above individual stage efficiencies in multistage turbines.

Pressure lines on the T-S and H-S diagram, Fig. 5, diverge with increasing entropy. This makes the sum of the stage constant-S expansions greater than the single constant-S expansion from inlet state, H_1, at P_1 to P_4.

$$H_1 - H_a + H_2 - H_b + H_3 - H_c > H_1 - H_E$$

This helps in recovering part of the lost work in each stage, but of course never recovers all of it. Ratio of these enthalpy differences is called the *reheat factor:*

$$RF = \frac{H_1 - H_a + H_2 - H_b + H_3 - H_c}{H_1 - H_E}$$

This compares the total available drop by stages to the drop available in a single expansion.

Example: A turbine with three stages takes gas at 1760 °R and 58.8 psia and expands it to 15.26 psia. Each stage has an efficiency of 80%. Find the overall turbine-engine efficiency and the reheat factor.

For these conditions the state at each point in Fig. 5 is:

State	T, °R	P, psia	H, Btu/lb
1	1760	58.8	438.83
a	1586	39.1	392.01
2	1621	39.1	401.37
b	1445	25.0	354.69
3	1480	25.0	364.03
c	1300	15.26	316.94
4	1336	15.26	326.33
E	1239	15.26	301.27

Substituting in the *RF* formula above we get a reheat factor of:

$$RF = \frac{46.82 + 46.68 + 46.95}{438.83 - 301.27} = \frac{140.45}{137.56} = 1.021$$

This means that multistaging increases the available energy drop by 2.1%. This recovers some of the losses to friction and turbulence.

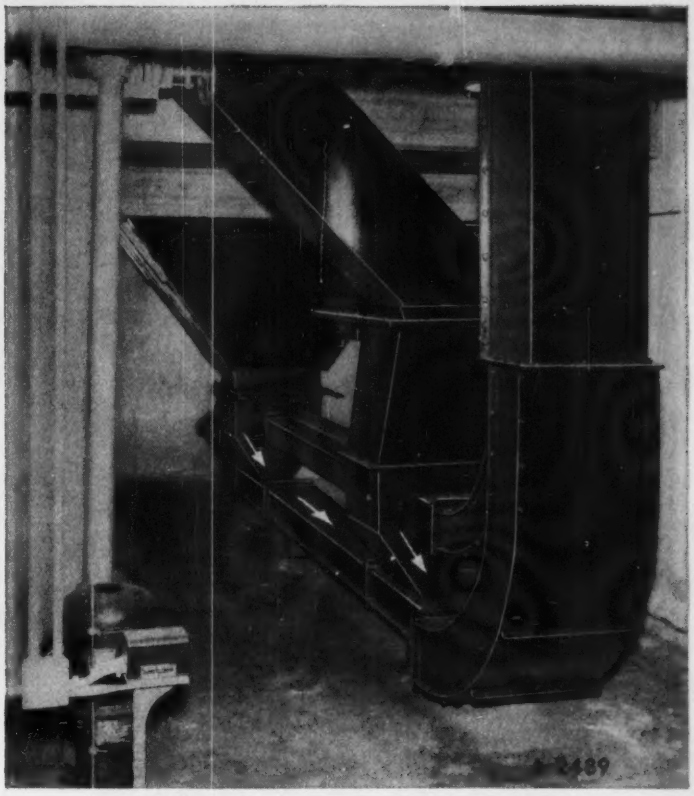
The overall turbine-engine efficiency is:

$$e_o = \frac{438.83 - 326.33}{438.83 - 301.27} = 0.818$$

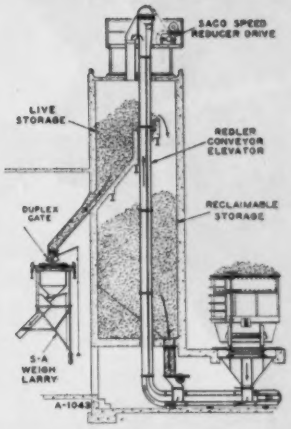
Turbine-engine efficiency is 81.8%. This compares with individual stage efficiency of 80.0% and shows the advantage of multistaging. If we expanded gas in one stage through the pressure range, engine efficiency would probably be less than 80.0%. Available work lost in the turbine is $H_4 - H_E = 326.33 - 301.27 = 25.06$ Btu per lb gas.

Next part will cover continuous-flow compressors and gas tables.

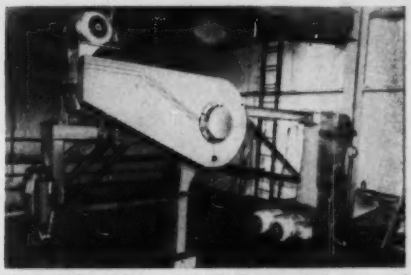
STEPHENS-ADAMSON



L-type REDLER Conveyor-Elevator System in Midwestern Power Plant

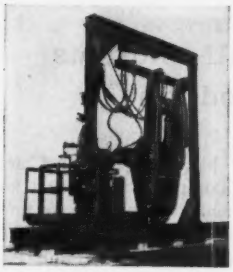


Drawing above illustrates flow of coal through a typical REDLER Conveyor-Elevator installation.



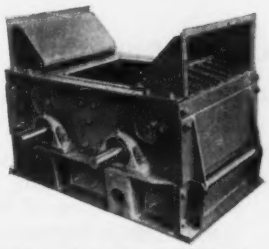
Vertical Closed-Circuit REDLER Elevator discharges coal into double-roll Knittel Sampling Crusher. Coal "cut" from main flow is sampled for B.T.U. content.

REDLER® Conveyor-Elevator INCREASES EFFICIENCY ...LOWERS COST IN COAL HANDLING!



S-A HYDRAULICALLY POWERED CARQUAKE — Maximum efficiency in unloading hopper cars *without* objectionable noise. One man controls operation. No expensive overhead structures — a completely self-contained unit. 2 types available.

WRITE FOR BULLETINS 358, 858 and 658



S-A RING TYPE DOUBLE ROTOR KNITTEL CRUSHER — Crushes lumps while in suspension . . . no breaker plates needed. Maintains full capacity with wet coal — no clogging. Greater capacity—less space required.

S-A
MATERIALS HANDLING PRODUCTS
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STEPHENS-ADAMSON engineered REDLER Conveyor-Elevator Systems backed by over a half century of coal handling "Know-how" provide dependable coal handling service at the lowest cost-per-ton figured over the life of the equipment. In the Midwestern installation shown above, an L-type REDLER Conveyor-Elevator System handles distribution from an unloading hopper to a storage silo and from reclaimable storage to live storage shelf or direct to boiler room. Dust is confined within the sealed REDLER casings thereby contributing to good housekeeping. S-A REDLER coal handling systems save space, offer flexibility in application and often combine both conveying and elevating operations usually with only one drive.

REDLER Conveyor-Elevators are available in sizes to handle practically any tonnage. They can be designed to fit into any new or existing structure and will occupy a minimum of space.

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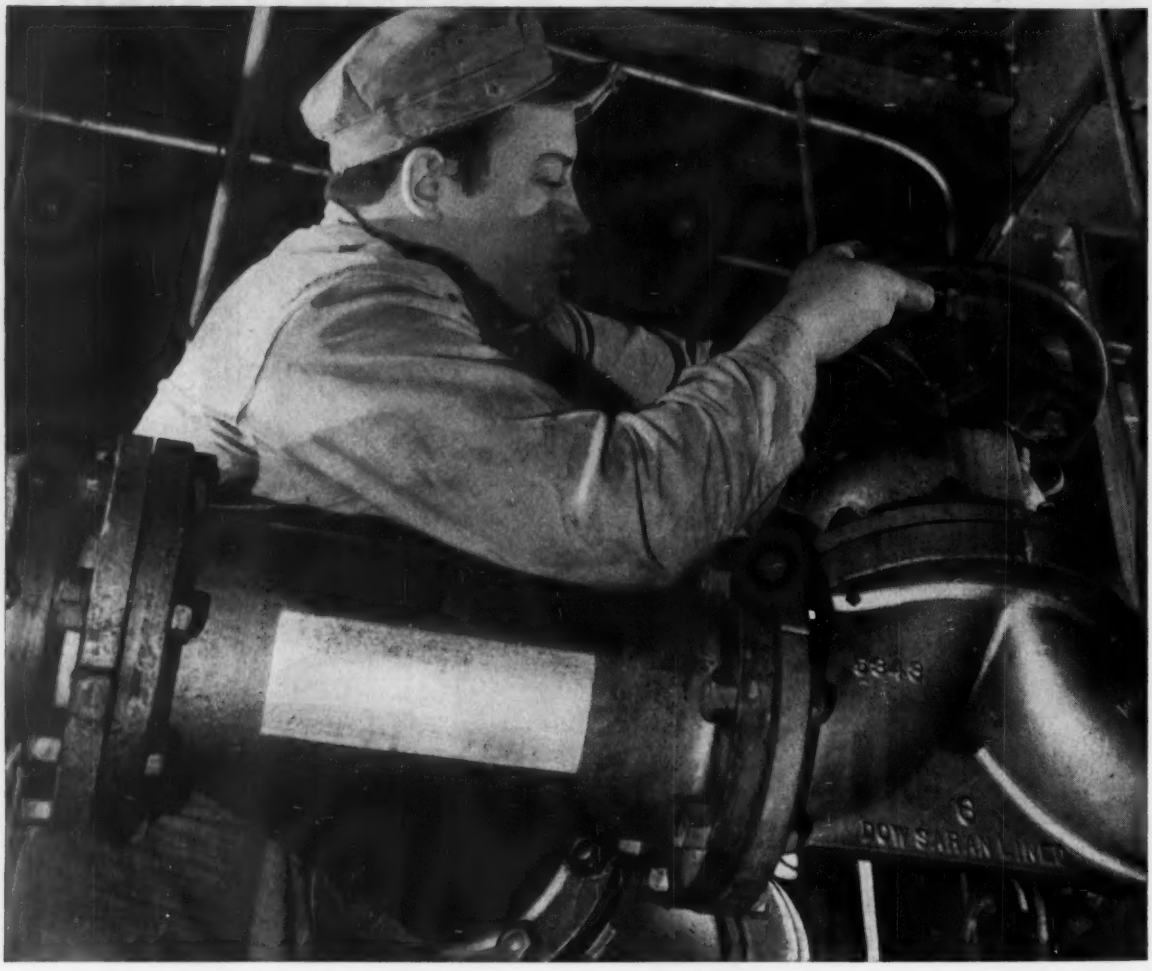
For more facts circle 312 on Reader Service card, p 121

DOW | **SARAN LINED PIPE**



After more than 3 billion pounds of acid and alkali solutions
No replacement of corrosion-resistant Saran Lined Pipe

When utility power plant piping must carry six million pounds a day of acid-and-caustic-treated water . . . piping in which a single failure would shut down the entire water-treatment system . . . dependable corrosion resistance becomes a matter of public safety.

Wisconsin Electric Power Company's Commerce Street power plant in Milwaukee furnishes steam for heating a 24 square-block area in downtown Milwaukee. In this plant Saran Lined Pipe is used to carry acid-treated and caustic-treated city water to cation and anion tanks for demineralization prior to use in the plant's high-pressure steam system. Approximately 725,000 gallons a day of the corrosive liquids pass through the system, one section of which is shown above.

Saran Lined Pipe was first installed in this power plant 2½ years ago. Since that time, despite a total volume flow of over *THREE BILLION* pounds, there's never been a replacement of the Saran Lined Pipe. Mr. Fred H. Long, Chief Chemist of Power Plants for the company, stated that an additional advantage of Saran Lined Pipe is ". . . we find that the pipe is relatively easy to cut to proper length. We don't have to order exact pre-cut lengths, then wait for delivery. This also . . . looks like the best type of pipe we've tried for resistance to corrosion and ease of maintenance.

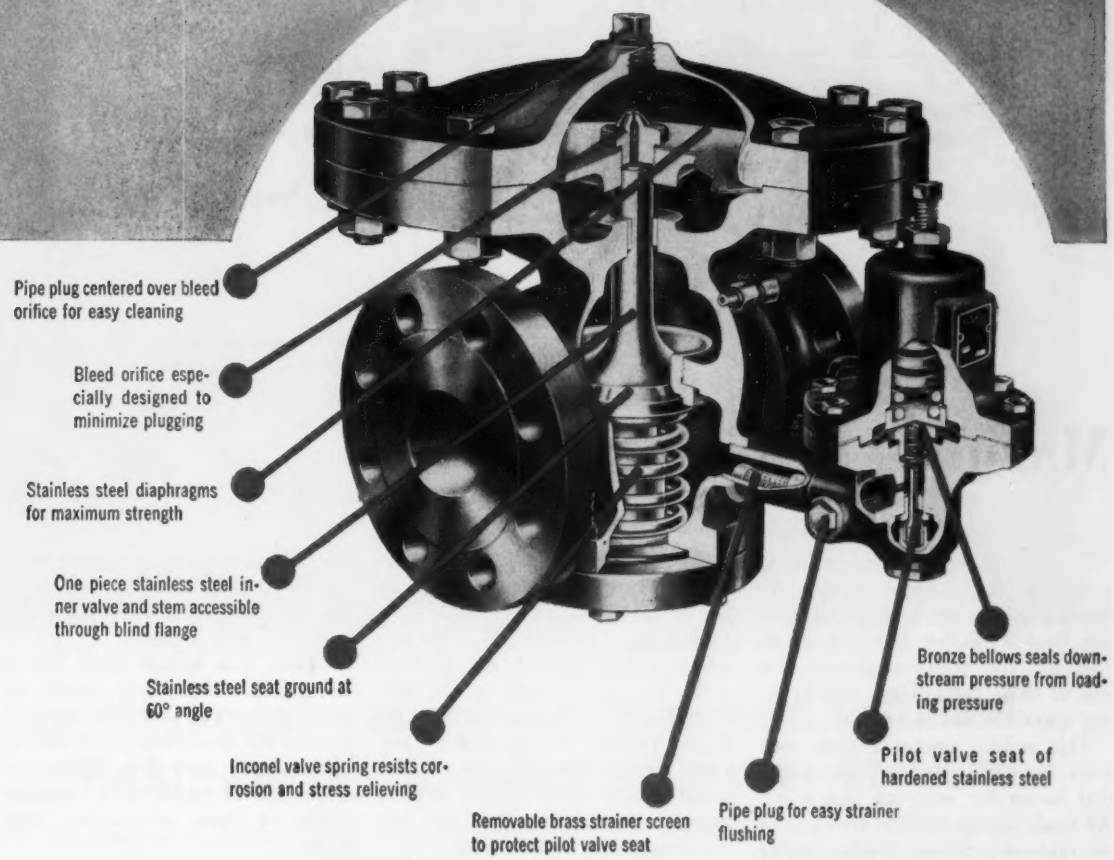
Whenever piping systems *must* resist corrosion and chemical activity, no matter how extreme the conditions, it'll pay to specify dependable Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2288DW9.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

THE FISHER® 92B

IMPROVED

TO MINIMIZE PROBLEMS INHERENT IN STEAM SERVICE


Pipe plug centered over bleed orifice for easy cleaning
Bleed orifice especially designed to minimize plugging
Stainless steel diaphragms for maximum strength
One piece stainless steel inner valve and stem accessible through blind flange
Stainless steel seat ground at 60° angle
Inconel valve spring resists corrosion and stress relieving
Removable brass strainer screen to protect pilot valve seat
Pipe plug for easy strainer flushing
Pilot valve seat of hardened stainless steel
Bronze bellows seals downstream pressure from loading pressure

Not content with the enviable performance record of the Type 92A, Fisher engineers have improved this pilot operated pressure reducing valve to a new peak of performance.

For extremely accurate, long trouble-free service, put a Fisher 92B in the line. One pilot with three interchangeable springs provides a range of from 2 to 150 psi. • ***Send for Bulletin D-92 today.***

Engineers with special problems . . . find the ***answer*** *in . . .*

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario

FISHER® Controls

For more facts circle 314 on Reader Service card, p 121

"We'll soon see what's been making the racket inside this cylinder," said the chief engineer

Marmy's lit piston

"BILGEWATER on blarney artists in power plants," roared Marmaduke Surfaceblow in his foghorn voice at the Bent Propeller Bar last night. "I'll tell you potted engineers how one of those fast-talking, gold-bricking operators almost lost a ship!"

This sudden pronouncement took place last night when I dropped into that haven for seagoing characters. All heads turned into the direction of the typhoon. Strong, weather-beaten men put down their gullet washers and tried to focus their bloodshot eyes on Marmy. I ordered a short beer and settled down to listen.

The old consultant slammed his bottle of Sandpaper Gin on the bar, then turned to face his admiring audience. Pulling himself up to his full height of 6 ft 4 in., he gave his battered gray derby a starboard list. Glaring at his listeners from one end of the crowded room to the other to let them know he was kingpin in that wolf's den, he hooked his thumbs into the armpits of his checkered vest, leaned back and began to blast away.

"Back in 1901 I was second assistant engineer aboard the cattle boat *SS Renshaw*," he bellowed. "She was a British ship, registered out of Liverpool. We carried cattle on the hoof from Boston to England across the North Atlantic, usually making one round trip a month. Her two double-ended coal-burning Scotch boilers supplied 200-psi steam to her big triple-expansion main engine.

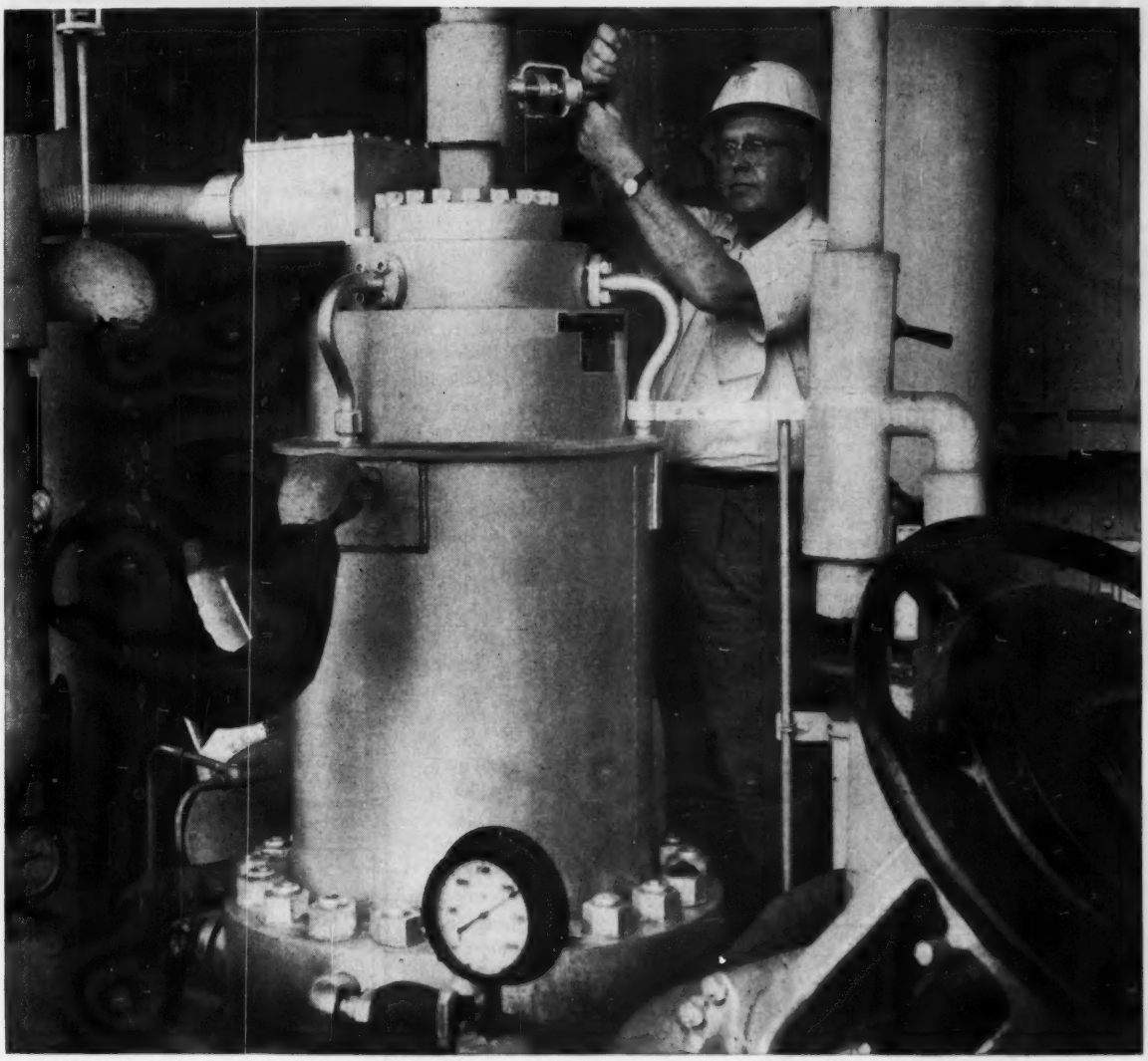
"Keeping steam up on those old kettles was a man's job. Shoveling coal, raking fires and hauling ashes in that tossing inferno kept the firemen punch drunk. With the ship rolling and pitching, a coal passer would push a wheelbarrow-load of coal out of the bunker onto the floor plates. Then he'd often go suddenly head over heels against the bulkhead as the *Renshaw* took a sudden roll.

"I stood more than one watch in the stokehold with a monkey wrench in my fist, swearing I'd wrap it around the first fireman who lay down on the job. Mostly tough characters sailed on the cattle boats. You had to be tougher than the firemen or they'd konk you with a shovel.

"Those rust buckets were floating stockyards. You could smell one while it was hull down on the horizon—if the breeze was right. Seemed like runaway farm boys bitten with wanderlust all ended up as chambermaids on those odoriferous cattle boats.

"In winter with the Atlantic kicking up her heels, the *Renshaw* would be on her beam ends one minute, then a green wave would crash over her bow putting her decks awash. The cattle in the holds were battered around with each roll until their bones were often crushed. They'd send up a constant chorus of mournful bellowing that made you happy to be in the engine or fire room where you couldn't hear them too well above the clattering machinery.

"We signed on a goldbricking third assistant engineer in Liverpool



VEPCO's Yorktown No. 2 installation shows one of three 7580-gpm canned motor-pumps operating at 2120 psi, 620° F on the controlled circulation boiler.

Westinghouse canned motor-pumps installed at Yorktown and Chesterfield power stations

Operating experience with a similar installation of Westinghouse canned motor-pumps on a controlled circulation boiler at Virginia Electric Power Company's Possum Point station led to the selection of this pump for both the new Yorktown and Chesterfield plants.

Proved in many utility installations, Westinghouse canned motor-pumps have a record of reliable service during long-term, continuous operations. They improve station efficiency, are easy to operate and require almost no maintenance.

- Pump and motor casings completely enclose the pump shafting, eliminating troublesome conventional shaft seals and power-consuming seal-injection systems.
- Watertight Inconel cans keep rotor and stator windings dry and trouble-free.
- Field inspection reports prove the reliability and minimum wear characteristics of water-lubricated bearings.

For full information on how Westinghouse canned motor-pumps can save you money in a controlled circulation boiler installation, contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, Atomic Equipment Department, Cheswick, Pa.

J-57021

YOU CAN BE SURE...IF IT'S Westinghouse

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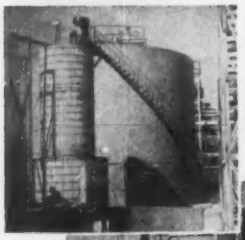
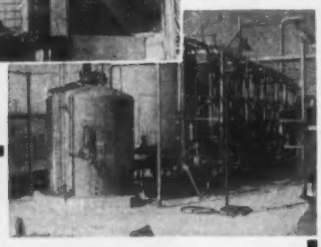
WHO CHOSE H&T ?

For Boiler Feedwater Conditioning Equipment



400,000 lb. per hour fully automatic demineralizer plant with silica and CO_2 removal



These Fine Companies Did!

A Partial List of Installations

Duquesne Light Co.
Shippingport, Pa.

Yankee Atomic Electric Plant
Rowe, Mass.

Ohio-Edison Co.
Akron, Ohio

Bowaters-Carolina Corp.
Catawba, S.C.

Knolls Atomic Power Laboratory
West Milton, N. Y.

The Cleveland Elec. Illuminating Co.
Ashtabula, Ohio

Chevrolet Div. Gen. Motors Corp.
Tarrytown, N. Y.

R. J. Reynolds Tobacco Co.
Stokes County, N. C.

Tampa Electric Co.
Tampa, Florida

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HUNGERFORD & TERRY, Inc.
CLAYTON 3 NEW JERSEY
H&T SERVICE

Marmaduke

Continued from page 176

one trip. Sean Rafferty talked a good job, but like a lot of slick, shifty operators, he couldn't be trusted. In port on both ends of the run the ship's crew would clean boilers and overhaul machinery. But Rafferty had a way of fluffing off in port instead of sweating it out with his men below.

"In Liverpool one trip Rafferty was to open the low-pressure cylinder and check her piston ring. Cylinder had a 56-in. bore. The 4-in. wide ring was held in place by a follower or junk ring. This ring was secured to the piston by two dozen one-in. cap screws. All Rafferty had to do to remove the piston ring for inspection was to remove cylinder head, cap screws and follower ring. Then he could screw three ¼-in. eye bolts into the exposed upper side of the piston ring and lift it with a light chain fall.

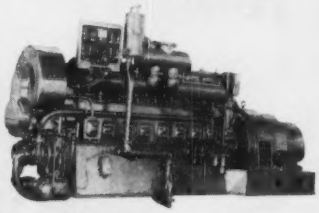
"The chief was in the port engineer's office all that morning checking stores and fuel bills. The first assistant had broken a leg and an arm during a big blow when he was thrown against the main circulator as we passed Bantry one night rounding England. He was in the hospital. I had all I could do to keep my rumdum firemen wire-brushing boiler tubes. Besides, we had some furnace grates to change, feed checks and belly plugs to grind in. We also had to clean the water side of the starboard boiler. So I couldn't keep an eye on Rafferty.

"All the work below was done in the light of duck lamps as the *Renshaw* had no electric lights. Those old duck lamps looked like a teapot and had a wick in the spout. They were filled with kerosene and smoked badly at times. Each fireman carried a lamp into the boiler and moved it around as he scraped and chipped scale.

"Just as I came up for chow at noon the chief barged up the gangplank from the port engineer's office. Rafferty was topside, leaning against the rail as usual, smoking his pipe and wisecracking with everyone. He was clean enough to go ashore. I was sweating and covered with soot and coal dust from working in the stokehold all morning.

" 'How does that l-p piston ring look, Mr Rafferty,' asked the chief, eyeing the Third suspiciously. 'She's

375kva diesel engine generator installed and operative in 48 hour crash program



ANP (Aircraft Nuclear Propulsion Division) Idaho Falls, Idaho, secured delivery for a priority program of a complete 375kva diesel engine generator set that was shipped 860 miles, installed and in operation 48 hours after ordering. The unit, in stock in the San Francisco area, was tested and shipped within 24 hours. The supplier, A. G. Schoonmaker Co., Inc., maintains a stock of 100kw to 1000kw diesel engine generator sets available for immediate delivery.

A. G. SCHOONMAKER *Company, Inc.*

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circle 317 on Reader Service card, p 121

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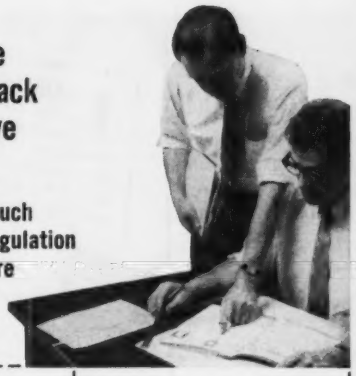
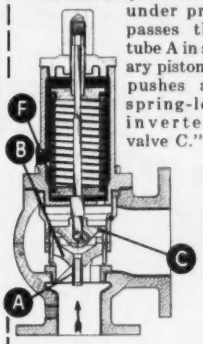
"How does the Klipfel #135 back pressure valve work?"

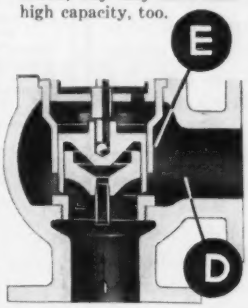
How can it give such close pressure regulation (4% over the entire capacity range)? Here's the story:



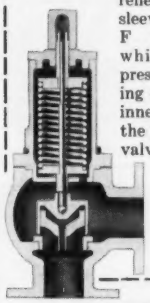
"Controlling inlet pressure and flow in a pipe line is all any back pressure valve does. How *well* it does this is, however, a different story. In this Klipfel Valve liquid under pressure passes through tube A in stationary piston B, and pushes against spring-loaded, inverted-cup valve C."



"When liquid pressure exceeds spring pressure, valve lifts open, letting liquid flow into outlet chamber D. This shows how Klipfel No. 135 Valves give such close regulation; why they have such high capacity, too.



"This is the same back pressure valve, modified to act as a relief valve. As you might guess, relief valves prevent excess pipe line pressures by relieving to the atmosphere. The only difference between the two valves is that the relief valve has no sleeve E and vent F (above)—which prevent pressure from acting downward on inner valve C in the back pressure valve."

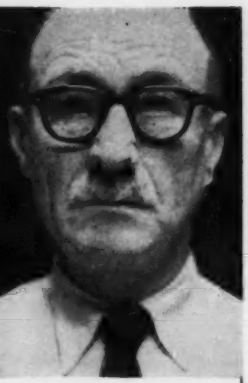


"MOST IMPORTANT FEATURE in any back pressure or relief valve (aside from dependability) is smooth, chatter-free opening and closing. Also, relief valves should close tightly, but this isn't so important in back pressure valves."

• **For the complete story of back pressure and relief valves, without cost or obligation, write for Bulletin 454.**

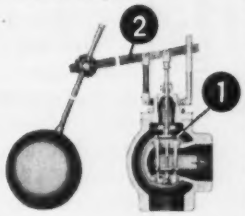
If you'd like information on Reducing Valves, ask for Bulletin 154 . . . and for valuable data on Temperature Regulators, Bulletin 354-A.

"Which type float valve do you need?"

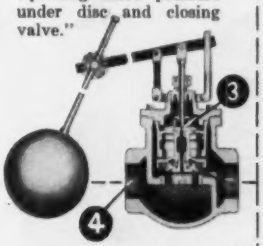


Here are some basic facts—taken from the Klipfel catalog*—which will help you decide.

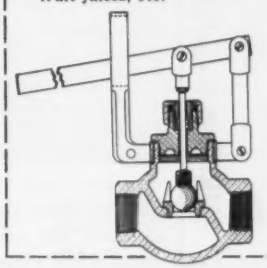
"To control liquid level in an open tank where tight closing is not essential, select a simple, direct acting, balanced float valve such as this Klipfel No. 27. Inner valve (1) opens as float drops. By reversing the lever (2), valve closes as float drops."



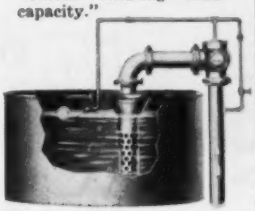
"Single seated float valves close tightly, prevent damage or waste from overflow due to valve leakage. Internal pilot action adds pressure of incoming liquid to buoyance of the float, keeping valve tightly closed. When pilot port (3) opens, water escapes through outlet (4). When it closes, pressure builds up above piston, equalling inlet pressure under disc and closing valve."



"This single-seated, all-metal float valve is ideal for tight closing with fluids injurious to rubber parts. Available in stainless steel or other corrosion-resistant materials to control levels of chemicals, fruit juices, etc."



"External-pilot-operated float valves use a small float valve in the tank to actuate a large main valve conveniently positioned outside the tank. This simplifies maintenance without reducing tank capacity."



***Much useful information on float valves and level control valves is available free in Klipfel Bulletin 254. Write on your company letterhead or ask for the complete catalog on all types of Klipfel automatic regulating valves.**

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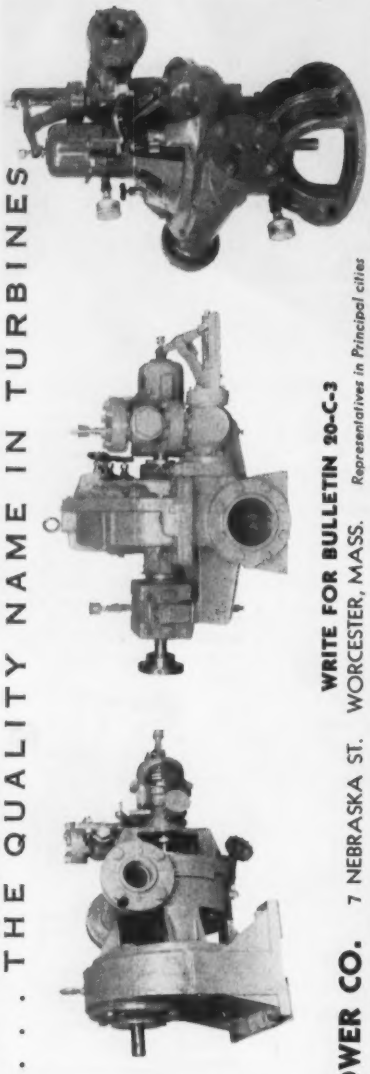

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CARLING TURBINES

Marmaduke

Continued from page 178

jolly well all righty,' answered the Third breezily as usual, flashing his best toothy grin. Then he added professionally, 'Plenty of tension, looks like it's got good contact all around.'

"The chief didn't say anything but walked quickly to his room. He looked beat, as if the port engineer had given him a tough time. He evidentally had things on his mind.

"Three days later we had steam up and shoved off for Boston. But soon as the main engine churned up to full speed there was a clicking sound in the l-p cylinder. By the time we dropped the pilot and opened up the engine to her full 90 rpm, that noise had become steady with each revolution. But it still wasn't too bad.

"First day out of Liverpool we hit dirty weather. To add to our troubles the boilers salted up from bum condenser-tube corset-string packing and started priming badly. We got busy pumping sawdust into the condenser and blowing down. Then with the main engine taking slugs of water the l-p started sounding like a rock crusher.

"The chief wanted to stop, but the skipper put his foot down. Said we'd capsize in that heavy sea if we couldn't keep the old girl's nose headed into the onrushing waves. He wouldn't take the chance unless there was a complete breakdown. So the main engine cranked away slapping and groaning. Most of the time we were hove to—making just enough speed to hold our bow into the mountainous waves so we wouldn't get a haymaker from a broadside.

Sixteen days later we pulled into Boston harbor six days late, some of us weary and jumpy. By then the l-p sounded like a cannon blast with each revolution. I expected that piston to come crashing through the cylinder head any minute.

"Each time the chief anxiously asked Rafferty if he was sure he had supervised the closing up of that l-p he got a big 'Hell, yes.' Then the Third would go into a song and dance, telling him the exact condition of the ring and exactly how he had tightened each capscrew holding the follower ring. He'd explain that he even removed the cotter pin from the piston nut and gave the nut a few

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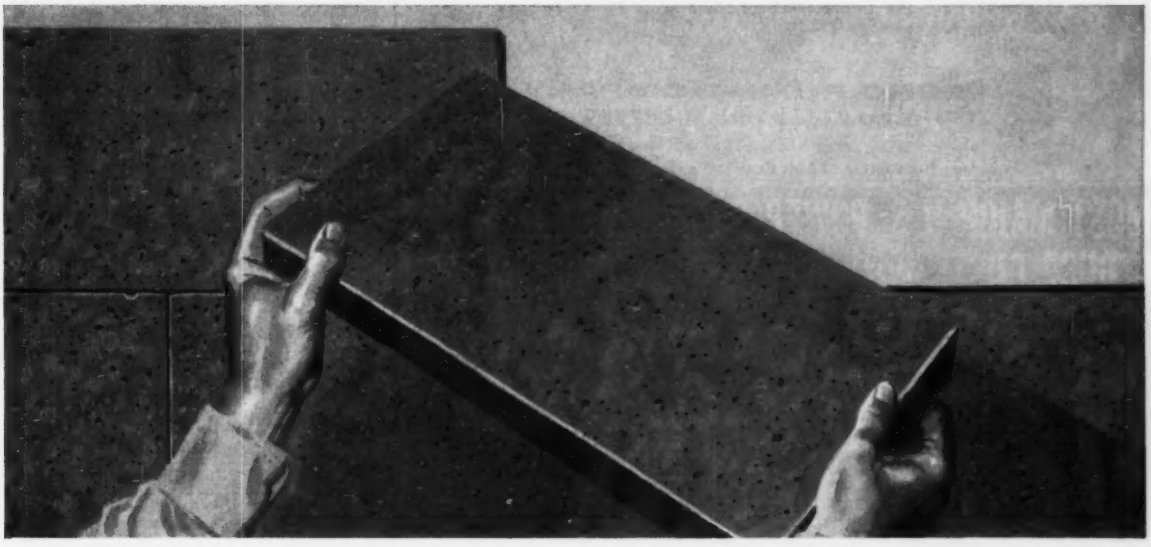

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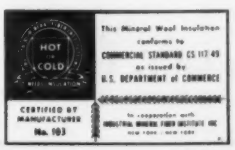

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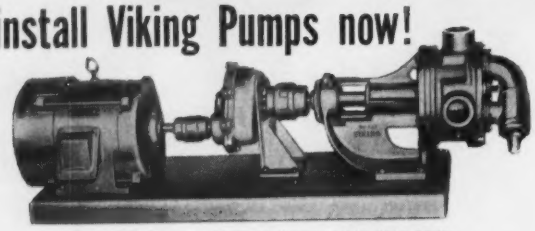

FIG. 288, HEAVY-DUTY PUMP WITH HELICAL GEAR DRIVE

Are you looking ahead to peak production? Will your pumps be operating full time, returning your investment, through the 60's . . . or will they need service and replacement?

You can depend upon VIKING POSITIVE DISPLACEMENT PUMPS to return your investment . . . to stay on the job . . . to give you FAST priming, strip your tanks if desired . . . to move thin or viscous liquids without excessive turbulence.

Read these actual statements from Viking Pump users—solid proof of top performance:

"This rugged old-timer of 25 years' service and NO repairs convinced us to buy a whole plant full of Vikings."

"I'm buying a heavy-duty Viking to add to my line. From the service I have had on the one for the past several years, I'll not hesitate to buy this improved model."

Look ahead to the 60's! And look to Viking Pumps for profitable operation. For information on the newest Viking Pumps send today for catalogs SP-488W.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "***ROTO-KING***" pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

For more facts circle 322 on Reader Service card, p 121

MOST MAJOR U.S. POWER PRODUCERS REDUCE COSTS with PANALARM ANNUNCIATORS

MAXIMUM INFORMATION on all process variables . . . the result of 10 years system engineering by Panalarm and major power producers. That's why Universal Series 50 is the power industry's most informative annunciator. Trouble anywhere is signalled instantly—*before* it can grow big and expensive. "Off-normals" are pinpointed instantly, accurately for fast remedial action, reducing costly "outage" losses.

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Ask your nearby Panalarm sales engineer to show you why Universal Series 50 is the power industry's No. 1 annunciator choice . . . how its adaptability and reliability can help increase your profits . . . by producing maximum information and reducing costly "outages." No obligation, of course.

Write for Catalog 100 B today.

PANALARM®
Division of
PANELLIT, INC.
7401 No. Hamlin Ave., Skokie, Ill.

Marmaduke

Continued from page 180

licks with a sledge hammer, to make sure the piston was tight on the rod.

"But the chief was skeptical. 'All right, Mr Rafferty,' he said coldly, 'We'll tie up alongside the dock in Boston at midnight tonight. I want you below at seven am. I'll be there with you while you open up that l-p cylinder so I can see exactly what's wrong. If I find that noise is caused by your neglect of duty, I'll report you to the British Board of Trade and see that your engineer's license is revoked. And I'm going to have the captain below to back me up.'

"Now Rafferty was a fast thinker. He had been in too many jams not to know how to slide out of most of them. So when we tied up at the Charlestown docks at midnight he made a deal with his oiler to call him at three am.

"Soon as he got below at three o'clock he went to work quietly with his oiler and opened the l-p cylinder. Lifting the cover he saw the trouble. The cap screws holding the follower ring had evidentally been screwed down only by hand. Then during two weeks of constant pounding, the piston strokes had finally loosened them a few threads. It was a wonder that their heads hadn't snapped off and that the cylinder head wasn't wrecked.

"Rafferty tightened the cap screws with a wrench that had a long convincer stuck over the handle. Then he dropped the big cylinder head and silently tightened the 2-in. cylinder stud nuts with another long-handled wrench. With that bit of business out of the way, he scooted up to his room and turned into his bunk, waiting innocently to be called.

"At seven am the chief was down below at the l-p cylinder. Rafferty slid down the handrails a few minutes later, yawned in the chief's face, stretched, then said cheerfully, 'Good morning chief, won't be long before we solve the mystery of the growling piston, eh what? Ho, ho, ho.' But the chief didn't laugh.

"By the time the cylinder nuts were removed and the head was ready to be lifted, there was an audience. The captain and the new first assistant were also on hand. The First peered inside. His eyes almost popped out of his head as he roared, 'I say, chief,

For more facts circle 323 on Reader Service card, p 121

for this type service . . . specify this **STRONG** *trap:*

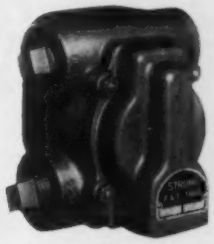
Dirty Lines or Dirty Steam:

Lowest Initial Cost per pound capacity:

Lowest Initial Cost per pound weight:

Eliminating Large Volumes of Air:

HYDRO-FLEX INVERTED BUCKET TRAP



FLOAT & THERMOSTATIC TRAP

Low Pressures with some air elimination:

Pulsating or Widely Varying Pressures:

OPEN BUCKET TRAP

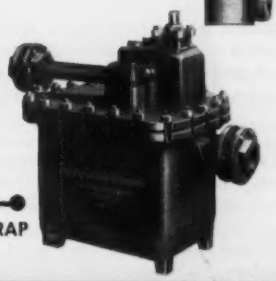
BALL FLOAT TRAP

Continuous flow required:

Draining a line carrying a vacuum discharging to atmosphere:

TYPE "A" VACUUM TRAP

Draining a line carrying a vacuum or very low pressure discharging against a hydrostatic head or back pressure:



TYPE "M" VACUUM TRAP

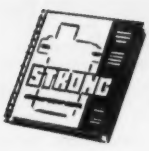
on every type service
STRONG steam traps give you longer life, less maintenance

Strong offers six types of steam traps to answer every requirement for removing condensate from all types of systems.

You can specify these Strong Traps with the assurance that you will get maximum service life. Proof is the fact that replacement parts are still being ordered for traps sold 50 years ago!

Here are some low maintenance features built into Strong Traps: Screwed-in, replaceable valves and seats of wear-resistant ANUM-METL. Deep-drawn, one-piece stainless steel buckets. Extra-heavy body and cover construction. Thorough testing. Interchangeable parts.

You will be money and years ahead when you specify Strong Traps. For further information, contact your local Strong distributor — he carries complete stocks and replacement parts, offers prompt service.



Selector Chart in Strong Catalog No. 69A gives trap recommendations for 45 types of equipment. Write for your copy or call your distributor.

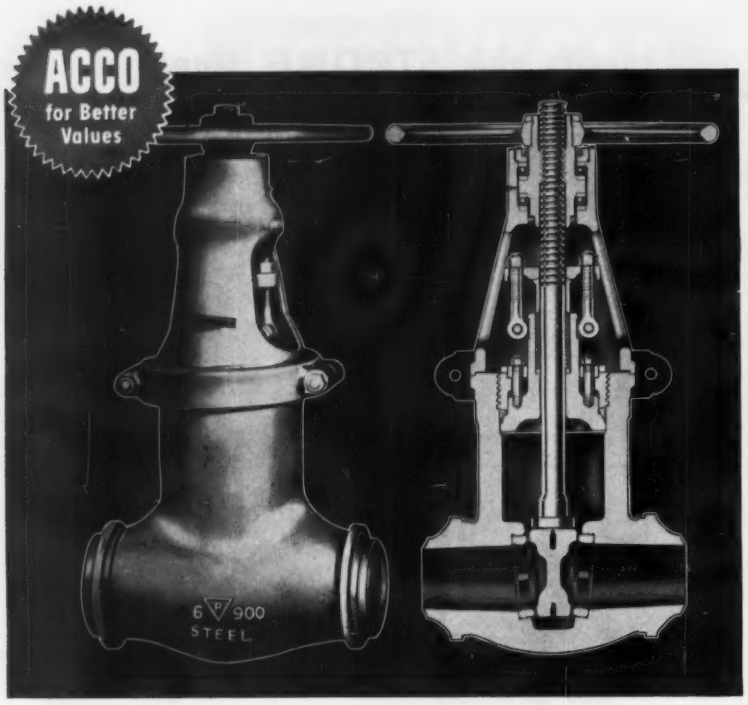
4/S

STRONG, CARLISLE & HAMMOND

508 Sandusky Street • Conneaut, Ohio

steam traps • air traps • float traps • vacuum or pumping traps
F and T traps • continuous blowdown valves • separators • engine stops

For more facts circle 324 on Reader Service card, p 121



R-P&C Pressure Seal Valves
for high pressure, high temperature applications

The soundness and reliability of the pressure seal bonnet joint in R-P&C high pressure cast steel valves has been thoroughly proven by field experience and use. Built to give continuous dependable service in modern high pressure systems, they offer these advantages:

1. **Pressure Seal Joint designed to secure maximum mechanical efficiency. Valve bonnet may be removed or re-assembled more readily than a conventional bolted bonnet valve**
2. **Elimination of flanges reduces weight in suspended piping**
3. **Modern design with neat contours facilitates insulation**
4. **Compensating type Wedge, adjusts for tight closure and to overcome sticking or jamming when seated**
5. **Manufacturer's complete quality control. Valve Castings are produced in R-P&C foundry under the supervision of R-P&C Technical personnel. All pressure seal valve castings are subject to critical internal examination in R-P&C's own Radiographic X-ray facilities**

R-P&C Pressure Seal Valves are available in gate design thru 14″ size. Globes and Lift Checks available thru 8″ size—all in the 900-1500 and 2500 pound classes.

R-P&C Distributors offer users in the Power Industry—in addition to these Pressure Seal Valves—a complete line of R-P&C gate, globe and angle valves in all standard materials: electric furnace iron, bronze, bar stock, cast steel...plus many specialties. See your distributor or write our Reading, Pa., office.

SEND FOR FREE WALL CHART

"How to Protect Your Valves"
This 22″ x 17″ chart gives valuable installation pointers, operating tips, clues to longer service life. For free copy, write us at Reading, Pa.

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ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

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Marmaduke

Continued from page 182

no wonder she chattered like a bloomin' ton of scrap iron. Blimy, if there isn't a duck lamp inside, sitting right on top of the piston.'

"The chief hurriedly wiped his bifocals with a red bandanna and adjusted them over his ears. He peered into the cylinder, then did a double-take. 'Yes indeed,' he said slowly stroking his sideburns and looking daggers at Rafferty. 'Not only is that duck lamp in perfect condition after sixteen days of constant pounding in the cylinder, Mr Rafferty, but can you explain why the bloody lamp's still lit?' "

—*Steve Elonka*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

MARMY FAN CLUB

Have you ever thought of a Marmy fan club—limited to qualified men, in the power field, or men recommended by those who qualify? Let Marmy represent the indomitable spirit that makes the individual, no matter what the wonders of equipment and automation, etc. For it's the individual that's still the dominant and most important force in industrial progress and development.

C R SAMPLE, *Milwaukee, Wis.*

MARMY AND GLENCANNON . . .

I agree, Colin Glencannon of the Inchcliff Castle and Marmy of the Bent Propeller Bar have much in common. If it's ethical in the writing fraternity, why not get the two old birds into the same story some time.

It would be interesting to see who could put away the greatest volume of his favorite tiger juice—Marmy ballasting his holds on Sandpaper Gin or Glencannon guzzling Duggan's Dew.

L MCWILLIAMS,
Shawinigan South, Que.

EDITOR'S NOTE: *Marmy is more interested in murdering science than stretching the contents of a bottle—but he may run into Glencannon some day.*

INSIDLINE® internal insulating systems for piping carrying gases at elevated temperatures and pressures, for service from 1000° F to 2000° F . . . EN 0® HIGH TEMPERATURE BLOCKS of pre-calcined diatomaceous earth, asbestos fib and inorganic

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(Advertisement)

HAGAN NEWSLETTER
Behind the Panel

MIDWEST UTILITY GETS POWRMAG COMBUSTION CONTROL SYSTEM

Another Hagan electronic solid state combustion control system has been contracted for by a Midwest utility for a new unit to be completed in 1961. A single furnace, single drum boiler, it will operate at 2200 psi and 1010 FTT, and have a maximum continuous capacity of 2,310,000 lb/hr steam. The Hagan systems will control combustion, fuel flow, air flow, furnace draft and pulverizer temperature and suction. Hagan's PowrMag (magnetic amplifier) components will be used for most control functions and the entire system will be solid state. Main reasons for the selection of the Hagan systems were low maintenance requirements, high accuracy and stability, and Hagan's experience. (Item H-1)

HAGAN METER AUTOMATICALLY COMPUTES "BLAST UNITS" TO BLAST FURNACES

At a leading steel company, air delivered to blast furnaces is charged to the Blast Furnace Department in terms of "blast units." A blast unit is a measure of work required to compress the air by turbo-blowers and is equivalent to 1000 kwh of electrical energy, or approximately 3,415 Btu. Blast units are calculated in terms of standard cfm air flow corrected to 15 psi gage. A common method is to integrate total air flow from air flow charts by the use of a planimeter and correlate with the pressure chart to 15 psi gage by applying certain correction factors. This method is laborious and subject to error.

However, since the installation of the Hagan Blast Unit Meter at an Eastern plant of this steel company, blast units are obtained automatically and precisely. Pneumatic signals, proportional to standard cfm and blower discharge pressure, are transmitted to the blast unit meter. The computing mechanism within the meter integrates and records blast units. Operating personnel now have an accurate and continuous record, eliminating compromise figures and manual checking. (Item H-2)

HAGAN POWRLOG TEMPERATURE CONTROLS FOR GLASS FURNACES

Fed with raw materials of special quality for the production of glass cloth, these furnaces must maintain extremely accurate temperatures in each of three sections. Initial melting is performed in the melter, maintained at 2800F. From there the glass flows to the refiner (2200F), and then to the forehearth (2200F), where the bushings through which the fiber is drawn are located. Hagan PowrLog units, with a suppressed range of 1600F to 3000F, take indications from Type R thermocouples and maintain required temperatures within 5F. Eight furnaces are under Hagan control as well as eight recuperators. Trouble-free operation, minimum maintenance and quick delivery were some of the factors which influenced the choice of Hagan as the supplier for these systems. Where even closer control is required, it is interesting to note that Hagan PowrAmp temperature controllers, sensitive to thermocouple fluctuations of one-millionth of a volt, are used to control bushing temperatures. These are held within 0.25F. (Item H-3)

GAS MIXING STATION GOES ON FULL AUTOMATIC IN HALF A DAY

This system normally utilized natural gas, but since a propane-air mixture must be used as standby, a gas mixing station was installed. Key item in the station was a standard Hagan Dual Ring Balance meter equipped with ratio control. Flow to equipment in the gas line is measured by one ring. This signal is used to control the flow of propane, which is measured by the other ring. The established ratio, resulting in a 1200 Btu propane-air mixture, is maintained throughout the range of the meter. This type of proportioning control is exact and is useful in a great many applications, including chemical feed and combustion control. The meter was installed and placed on full automatic in half a day's time. When, at a later date, demand on the station changed, the Hagan meter was changed to the new, higher range by a simple and easily made field adjustment. (Item H-4)

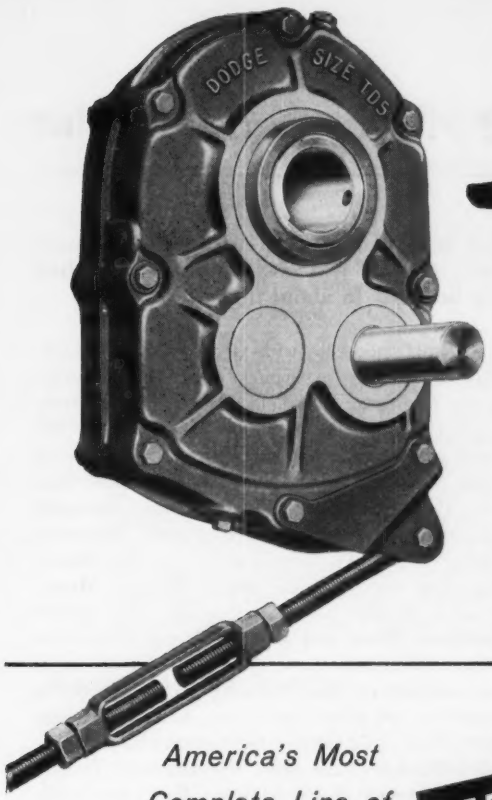
HAGAN CHEMICALS & CONTROLS, INC.

Hagan Building, Room 707, Pittsburgh 30, Pennsylvania
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

If you would like more information on any of the above items, check the appropriate box below.

☐ Item H-1 ☐ Item H-2 ☐ Item H-3 ☐ Item H-4

For more facts circle 327 on Reader Service card, p 121



Torque-Arm

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America's Most Complete Line of Shaft Mounted Speed Reducers

55 MODELS

- Capacities up to 170 hp
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- Single Reduction
- Double Reduction
- 5 to 1 Ratio
- 15 to 1 Ratio
- 25 to 1 Ratio
- Any speed ratio up to 150 to 1 obtainable by selection of pre-determined combination of reducer and V-belt drive.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

In fewer than ten years, the range of Torque-Arm Shaft Mounted Speed Reducers has increased from 6 to 55 models, to meet the ever increasing demand for this improved method of speed reduction.

By eliminating foundation, sliding base and flexible coupling this modern speed reducer has saved untold installation time and untold dollars of cost.

The rugged semisteel housing developed by Dodge has never been improved upon. It is corrosion resistant—and it has the strength to hold bearing seats in line for the life of the unit.

Dodge design provides wide spacing for the bearings. Loads are carried easily, contributing to Torque-Arm's long life and very high efficiency. The gears are finest quality—helical, heat treated steel.

Torque-Arm mounts vertically or horizontally in any position around the driven shaft. It locks to the shaft on *both* sides of the housing. The holes in the output hub provide simple removal with puller. Overload release and built-in backstop are optional.

Dodge Torque-Arm is America's most widely used shaft mounted speed reducer. It is stocked by your local Dodge Distributor. Ask him. Or write us for bulletin.

DODGE MANUFACTURING CORPORATION, 3200 Union, Mishawaka, Ind.

DODGE
of Mishawaka, Ind.

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Powerscope . . . A selective look at

Special talent in metals

Metals of high purity (99.99%) show astonishing changes in properties compared to their slightly contaminated states. For instance, commercial grades of beryllium are very brittle, shattering easily when hit hard. But at 99.99% purity the metal proves to be very malleable; it can be shaped almost as easily as copper. When electricity flows through commercial-grade bismuth telluride its temperature does not change. But high-purity bismuth telluride becomes very cold when conducting electricity.

Du Pont is concentrating on development of high-temperature metals by erecting a metallurgical research center in their Baltimore plant. Center will be able to handle refractory metals such as niobium (columbium), tantalum, titanium, zirconium, tungsten and chromium. Attention will focus on pure niobium and titanium metals.

Hoover Dam will be completed with installation of its last and largest unit, a 100,000-kva 180-rpm 16.5-kv generator. This 17th unit will raise station capacity to 1,344,800 kw. Scheduled for 1961 start, unit will be built by Allis-Chalmers Manufacturing Co.

Novosibirsk Power Scheme in the U.S.S.R. now runs at ultimate capacity with backing up of the Ob River to its top water level. Plant has seven units of 400-mw capacity each, for a total of 2800 mw. The headwater reservoir called the Ob Sea is 120 miles long and from 14 to 16 miles wide.

National Science Foundation finds that 76 Soviet scientific journals are now available in English translations. This compares with 2026 scientific journals and serials published in the U.S.S.R. Translations are listed in the *Monthly Index of Russian Accessions* published by Library of Congress. Many publications of U.S.S.R. institutions are available on an exchange basis. All translations are listed in *Technical Translations* published bimonthly by U.S. Department of Commerce. Translation programs in the U.S. tend toward cover-to-cover scope rather than just individual papers—it's cheaper that way.

A bigger, new type of machine will supersede the Zeta in Britain's thermonuclear experiments. While using a tubular ring-like shape as in Zeta, new device will have a more complex magnetic system to improve stability and eliminate losses in the pinch effect. New Intermediate Current Stability Experiment (ICSE) will cost about $1.4 million and be ready in about three years.

Nine firms cooperate with General Electric Company in building experimental extra-high-voltage power line near Pittsfield, Mass. (see POWER, April 1959, pp 168-9.) The 4½-mile line will eventually carry power at 750 kv. Cooperating firms include: Anchor Metals, Inc—two steel towers; Peterson Engrg Corp—tension stringing equipment to hoist steel-reinforced aluminum cables; Brewer-Titchener Corp—corona shields, conductor clamps, yoke plates; Western Massachusetts Electric Co—power supply and system operation; Stone and Webster Engrg Corp—line design and construction; Aluminum Co of America—conductors, bus, lightning spires, substation structures, one aluminum tower; American Bridge Div of U.S. Steel Corp—steel towers; Rilco Laminated Products, Inc and Weyerhaeuser Timber Co—one laminated wood tower. The 5-year project will cost about $7.5 million.

New fuel trend coming?

Fuel price increases during the last ten years have varied markedly with type of fuel. Here are comparisons for 1949 and 1958 with relative increases:

Bituminous coal per ton—$4.88 to $5.00—2.5%

Crude petroleum per bbl—$2.54 to $3.01—18.5%

Natural gas per mcf—6.3 to 11.7c—87.7%

F F Kolbe, past-president of the National Coal Association, predicts that coal will have a larger share of the energy market in the future and will enjoy a bigger growth rate.

Revival of the electric automobile may change future fuel-consumption pattern, shrinking oil demand and raising coal demand. Several builders in field will test cars in various areas of U.S. Present batteries give cars a range of 75 miles without charging, at speeds up to 40 mph. Some manufacturers predict ranges of 300 miles. Batteries can be recharged by plugging into any standard outlet.

World's first offshore sulfur mine, about seven miles out in the Gulf of Mexico off Grand Isle, La., will soon start operations. Freeport Sulphur Co will have a pipeline carrying molten sulfur from the mine platform standing in 50 ft of water to shore at Grand Isle. Three Worthington pumps will handle hot water at 330 F jacketing the line

to keep the sulfur molten. Two of the pumps at the mine-site platform will be steam-turbine driven, a third motor-driven pump will be on emergency standby at Grand Isle.

Dominion Engineering Company Limited of Montreal, Canada will supply ten kaplan type hydraulic turbines for Wanapum Development on the Columbia River in state of Washington. Each turbine will have a rating of 120,000 hp at 80-ft head and 85.7 rpm. These will be among largest units of their type. Public Utility District No. 2 owns the development 415 miles above mouth of the Columbia River. Ultimate capacity of the 16-unit project will be 1,920,000 hp.

Water holds back water

Collapsible dam invented by N M Imbertson of Los Angeles Department of Water and Power saves about $75,000 worth of water annually on the system. Dam is a synthetic rubber tube reinforced with nylon fabric, 150-ft long and 30 ft in circumference. Water fills tube fastened to bottom of channel to form a dam about 5-ft high. When flood waters exceed a given height a syphon arrangement drains tube, allowing it to collapse and pass the flood water. Refilling raises the dam.

Power from geothermal steam will be produced in the U.S.A. by Pacific Gas and Electric Company in an area about 90 miles north of San Francisco. Initial plant will generate 12.5 mw. Wells are being driven by Thermal Power Company who will sell the steam to PG&E. A resort hotel in the area has been using the steam in a 4-hp engine for the past 35 years to generate electricity for its use. Smaller steam engines using the geothermal steam drive local water pumps.

National Electrical Manufacturers Assn and Electronic Industries Assn have integrated programs to give broader coverage of technical standards and marketing data on semiconductors. NEMA will cover rectifiers and controlled rectifiers while EIA covers diodes and transistors for signaling and low-level switching. They'll divide the power transistors between them. Joint program works through 13 committees, meeting as often as 13 times yearly.

Arabian American Oil Company has about 163 million cu ft per day of natural gas for sale in Saudi Arabia; by 1961 figure will rise to 214 million. Gas is in five oil-producing areas. Another area will be added next year. Most of the gases are unprocessed and contain hydrocarbons, CO_2 and HO_2; heating values vary from 900 to 2600 Btu per cu ft. Delivery will be at or near gas-oil separating plants scattered in the province. Buyers will own and run transportation lines. Contract terms will generally run for 20 years. Gas is offered by Aramco at urging of Saudi Arab government.

Power growth overseas

Egyptian Electrical Equipment Company in a plant near Cairo has started producing the first transformers, switches, cables and distribution gear to be manufactured in any Arabian country. Company has been licensed by the Siemens Schuckertwerke of West Germany who own 20% of the stock. Plant will save Egypt about $2 million of foreign currency annually.

Federal Electric Commission of Mexico says the country will have to spend more than $900 million in the next five years to meet rising demand for electric power. FEC expects 2.5-million kw will have to be installed; government will need to spend about $500 million of the total. They will be seeking about $200 million in foreign credits to carry out this program; Japan, European Common Market countries and Westinghouse Electric Corporation have already offered some financing.

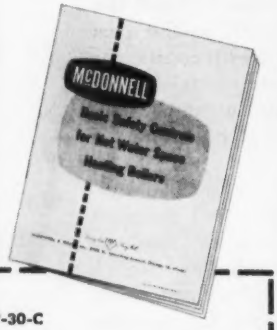
Erie City sales agents attended their 1959 sales conference at Erie City Iron Works on July 13 to 16. They discussed all classes of steam-generating equipment with the home-office engineering staff, inspected designs, methods of manufacture.

NEW BOOK THAT CAN DO A JOB FOR YOU!

Covers the WHY and HOW of Basic Safety Controls for Low Pressure Steam Boilers

Here is a book that deals in brass tacks solely. It tells its story in simple diagrams and equally simple explanation that wastes no words on product description. It sticks to fundamentals and concrete recommendations that answer practically all safety control problems encountered in the low pressure steam field. So well classified and indexed are the facts that, whatever your job, you can turn right to the most authentic way of handling it: The right product . . . the correct hook-up . . . the proper wiring. *Use the coupon to request your copy*, and if you do not have the earlier "hot water" booklet, request it too.

This new "Low Pressure Steam" booklet was inspired by the widely praised booklet on "Hot Water Boilers." These two companion-pieces can do a real job for you.



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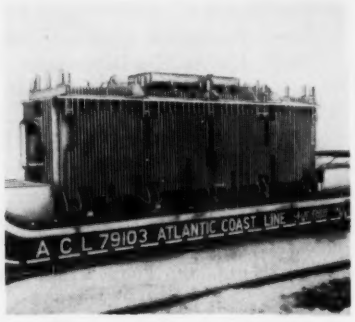
Reports from the field

Columbia U accelerates embryo engineers

Over seventy talented high-school students spent their vacations taking Columbia University courses in advanced math, geology and thermodynamics last summer. Sponsored by the National Science Foundation, the program had some students living and studying at a summer engineering camp in Connecticut for six weeks, while others commuted from their homes to Columbia's labs.

To select students, the college considered and tested two applicants from each high school. All books and study materials were supplied for successful candidates, and room and board at the camp was free.



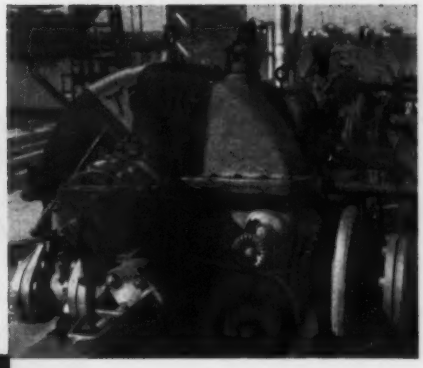
Casks ship radioactive materials safely

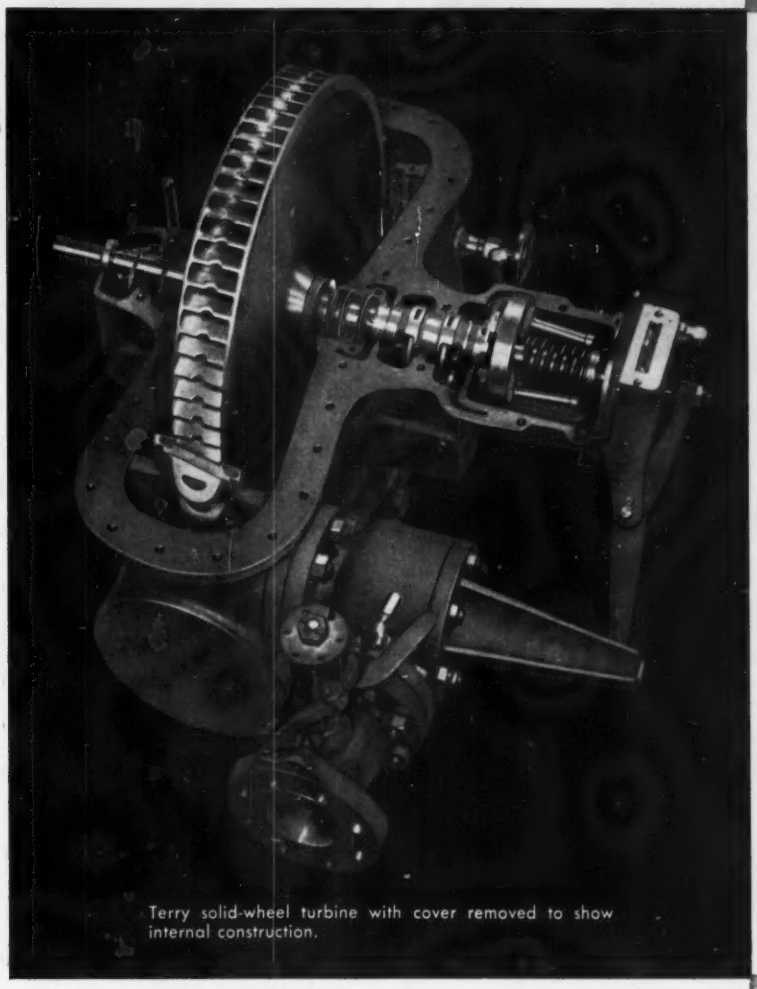
Chemically pure lead, 8½ in. of it, is sandwiched between ½-in. plates of stainless-clad steel to achieve rigidity, strength and radiation-shielding properties in these shipping "casks." Built for E I duPont de Nemours & Co, containers will be used to carry fissionable material and radioactive waste over normal shipping routes without radiation danger.

Containers are 18-ft 9-in. long, 5-ft 9-in. wide, 6-ft 2-in. deep. An 8½-in. space between two steel boxes, one set within the other, is filled with lead so that the finished container combines interior and exterior surfaces of stainless steel with the radiation-shielding properties of solid lead. Welded to outer surfaces of each cask are stainless-steel fins 4-in. long, placed 1½-in. apart. These provide surface area needed to dissipate heat

TERRY SOLID-WHEEL TURBINE

spells service continuity for mechanical drives





Terry solid-wheel turbine with cover removed to show internal construction.

For mechanical-drive applications, such as these, you will never find the equal of Terry solid-wheel turbines for built-in dependability. They are *designed* for trouble-free operation under the toughest service requirements.

The wheel, for example, is a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out. The blades can't foul since they are double-rim protected... with one-inch clearances at either side.

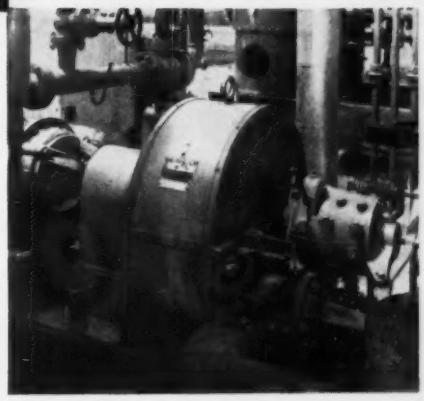
Any blade wear, which might occur after years of service, is of little consequence. As the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets, wear does not materially affect horsepower or efficiency.

Specify Terry solid-wheel turbines for your next mechanical drives. They are available in capacities from 5 to 2,000 hp., speeds up to 10,000 rpm. Vertical turbines are built in sizes from 5 to 300 hp.

For full information about these reliable turbines, send for bulletin S-116.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



TT-1216

For more facts circle 330 on Reader Service card, p 121

The design work on all these new substations is going to be hard to handle with our present force.

Of course! They have enough to do handling routine duties. Why don't you call in PIONEER?

GIVE YOUR NON-ROUTINE OPERATIONS TO PIONEER

Design and Consulting Engineering Services

Pioneer has specialized in designing power plants for 57 years. It offers design service for fossil-fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and in supervising construction. Pioneer's other services include substation, transmission and distribution studies and design.

Services in Regulatory Matters

Pioneer offers its services in all phases of Federal, State and Local regulation including the rate base, depreciation analysis, cost of service studies, market analysis, certificate proceedings and rate of return.

Corporate Services

Pioneer's services in corporate matters include business and management engineering advice, financial, accounting and tax counsel and insurance and pension plans and programming. It maintains a complete stock transfer, ledger and dividend disbursement service.

NEW! On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes, illustrates Pioneer's engineering services, and corporate services, from financing to operation.

57 YEARS

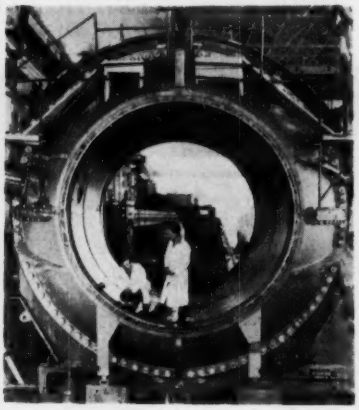
Pioneer Service & Engineering Co.

231 South La Salle Street
Chicago 4, Illinois

Reports from the field

Begins on page 190

generated inside cask. Built by O G Kelley & Co of Boston, casks weigh 75 tons each. Nine of them have been ordered.



Giant hydro valve made by international effort

Cooperation between English designer and Canadian manufacturer produced this smooth-bore valve for a St. Lawrence Seaway hydro project. There are five of the big valves, with 12-ft bores, 22½-ft diameters. They will control turbines rated at 180,000 hp at Quebec Hydro-Electric Commission's Bersimis II station on the north shore of the St. Lawrence.

Calendar of Events

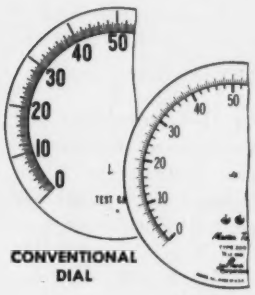
Sept 17-18—American Society of Mechanical Engineers, Engineering Management Conference. Statler-Hilton Hotel, Los Angeles, Calif. Details from ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Sept 21-25—Instrument Society of America, 14th Annual Instrument - Automation Conference and Exhibit. International Ampitheater, Chicago, Ill. Details from H S Kindler, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

Sept 22-24 — Armour Research Foundation and **Nucleonics Magazine,** with cooperation of AEC,

For more facts circle 331 on Reader Service card, p 121

Presenting New MARSH "*Master-Test*" SERIES
of extremely accurate test gauges

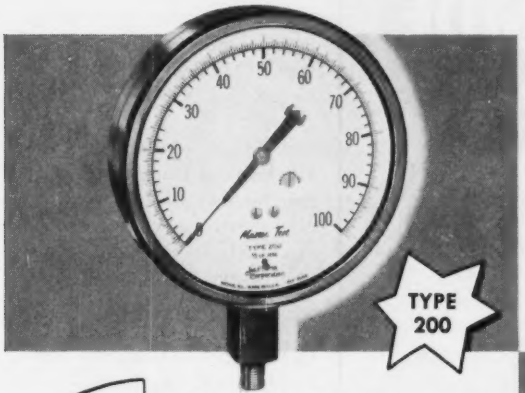


Crowning achievement in instrument making... this superb series of test gauges developed to meet today's exacting requirements of instrument men throughout industry. Accuracy and dependability beyond compare...each gauge individually dead-weight tested (think what that means!)...each gauge guaranteed accurate within ¼ of 1% plus or minus of the maximum dial reading over the entire range.

To provide reading accuracy in keeping with the accuracy of the instrument, all "Master-test" gauges have the simplified "Read-easy" dial (patent pending) illustrated opposite—a dial that can be read with the accuracy of a caliper, yet with the ease of a clock.

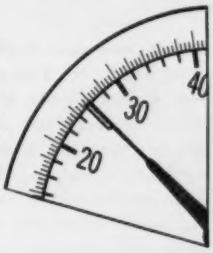
To further increase accuracy, three advanced means of reading have been developed as described below: the "twin-tip" pointer; the mirror path; the non-parallax dial.

"Master-test" gauges are available in sizes 4½", 6", 8"... in all standard ranges from 0-15 to 0-30,000 psi... in vacuum and compound types... in a full range of case patterns. Ask for 20 page bulletin.



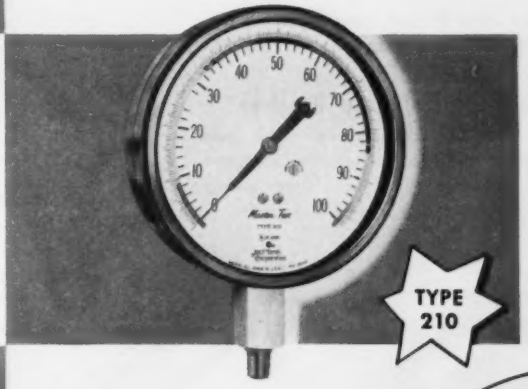
← with "Twin-tip" pointer

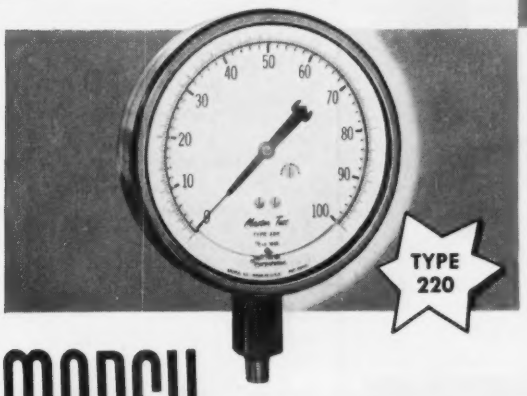
The most common error in reading pressure occurs when the observer reads from an angle rather than "dead on". This Marsh "Twin-tip" pointer enables the operator to know when he is dead on by lining up the two tips so that only one is visible. The twin-point arrangement is similar to the sights on a rifle.



with mirror dial →

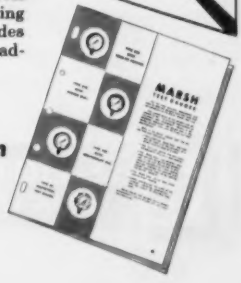
Another method of insuring accurate "dead on" reading. Knife edge pointer is reflected by the mirror path. When reflection is not seen, reading is dead on and true. The ease and accuracy with which the mirror dial may be read cannot be duplicated by any other mirror type dial. It is the combining of the mirror path with the exclusive Marsh "Read-easy" dial that makes this faster, error-free reading possible.





← with "Non-parallax" dial

This Marsh development eliminates mistakes in dial reading even if read at an angle. To accomplish it Marsh engineers designed a clear Plexiglas insert placed, as shown, over the fine graduations so that they appear to be at the same level as the pointer regardless of the viewing angle. The "Non-parallax" dial provides the easiest and most accurate dial reading available.



Ask for this 20 Page Bulletin

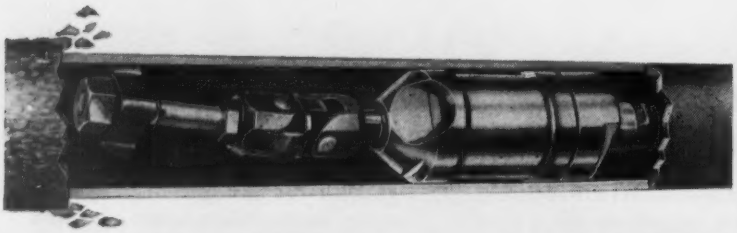
MARSH

THE STANDARD OF ACCURACY

MARSH INSTRUMENT COMPANY, Dept F, Skokie, Ill.

Division of Colorado Oil and Gas Corporation • **Marsh Instrument & Valve Co., (Canada) Ltd. 8307 103rd St., Edmonton, Alberta, Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas**

For more facts circle 332 on Reader Service card, p 121



ROTOJET®

Cleans Fire Tubes ▸▸▸▸▸▸ FAST ▸▸▸▸▸▸▸

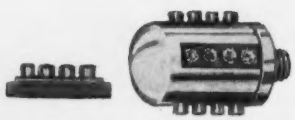
INSIDE *and* OUTSIDE

You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

Try the new Rotojet, and no other tube cleaner will ever satisfy you.

Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.

Model S52S ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model S50S ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

Reports from the field

Begins on page 190

Third Industrial Nuclear Technology Conference. Morrison Hotel, Chicago. Further details from L Reiffel, Co-chairman, ARF, Technology Center, Chicago 16, Ill.

Sept 28-Oct 1—American Society of Mechanical Engineers and **American Institute of Electrical Engineers,** 1959 National Power Conference. Muehlebach Hotel, Kansas City, Mo. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 6-9—Stanford Research Institute, International Symposium on High-Temperature Technology. Asilomar Conference Grounds. Details from Stanford Research Institute, Menlo Park, Calif.

Oct 20-22—American Society of Mechanical Engineers and **American Society of Lubricating Engineers,** Lubrication Conference. Sheraton-McAlpin Hotel, New York City. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 27-29—American Society of Mechanical Engineers and **American Institute of Metallurgical Engineers,** Solid Fuels Conference. Cincinnati, Ohio. Details from ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 28-29—Armour Research Foundation of Illinois Institute of Technology, Computer Applications Symposium. Morrison Hotel, Chicago. Details from M J Jans, ARF, 10 W 35th St, Chicago 16, Ill.

Steam power plant north of Rapid City, S. D. will cost $5 million, have initial 22,000-kw nameplate capacity.

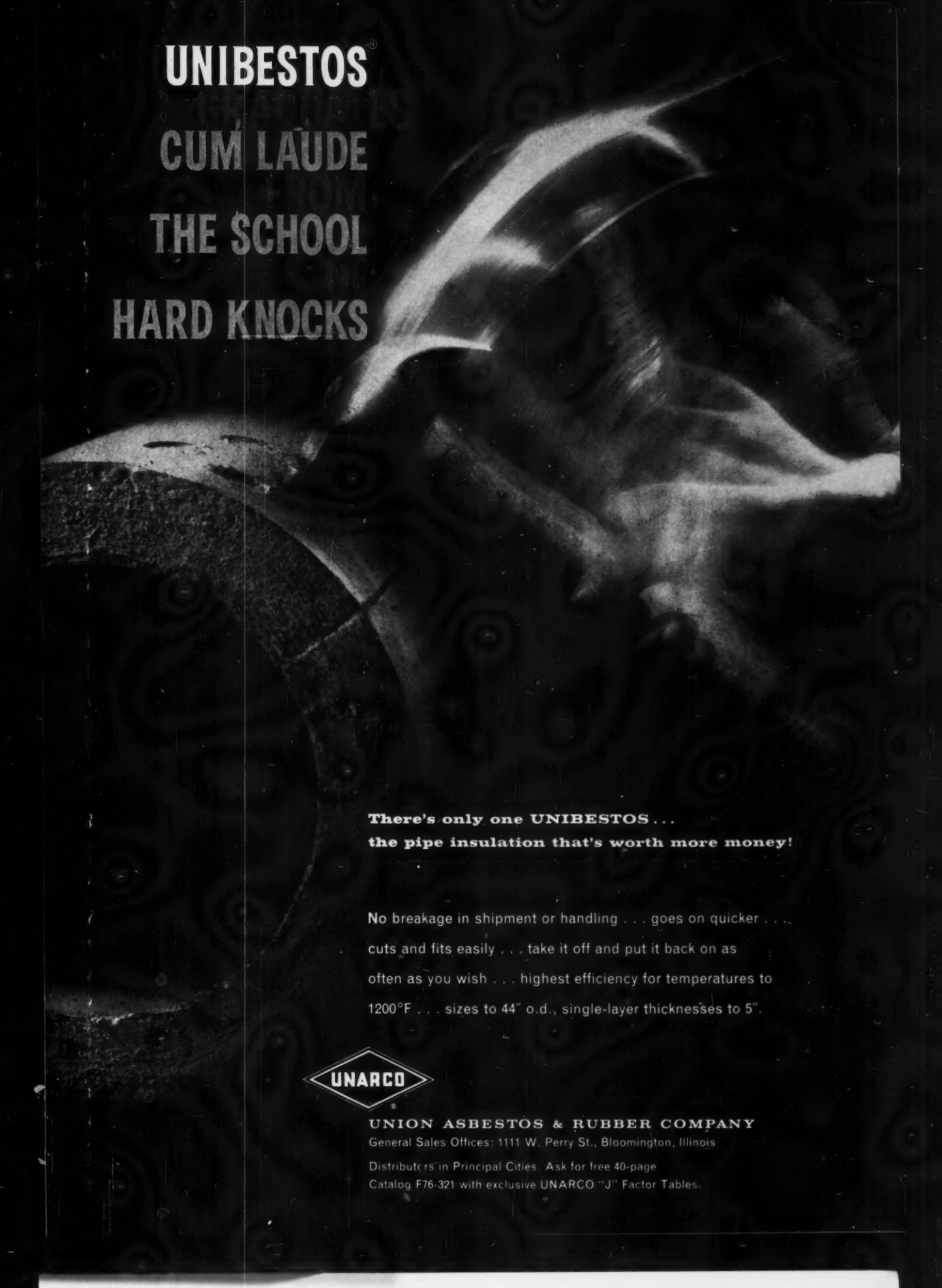
Spain's Guardo thermal power plant will burn fuel from La Robla coal **basin, supply** 187,500 kw to Spanish northern power network.

Cabinet-level Department of Science and Engineering is goal of Engineers Joint Council. Administrative department would serve national economy and defense.

continued

circle 333 on Reader Service card, p 121

circle 334 on Reader Service card, p 121 ➤



There's only one UNIBESTOS . . .
the pipe insulation that's worth more money!

No breakage in shipment or handling . . . goes on quicker . . . cuts and fits easily . . . take it off and put it back on as often as you wish . . . highest efficiency for temperatures to 1200°F . . . sizes to 44" o.d., single-layer thicknesses to 5".

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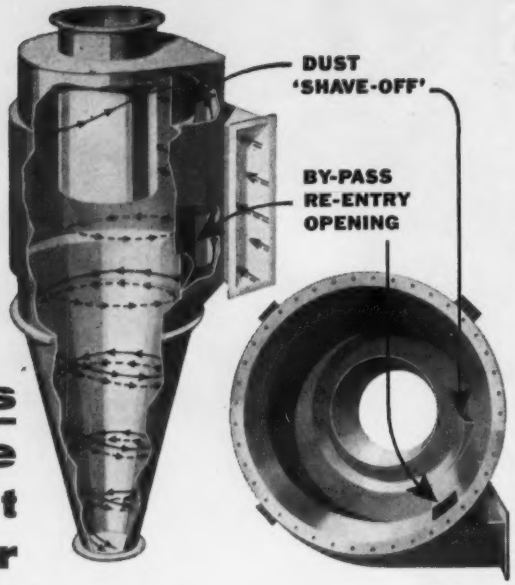
General Sales Offices: 1111 W. Perry St., Bloomington, Illinois

Distributors in Principal Cities. Ask for free 40-page Catalog F76-321 with exclusive UNARCO "J" Factor Tables.

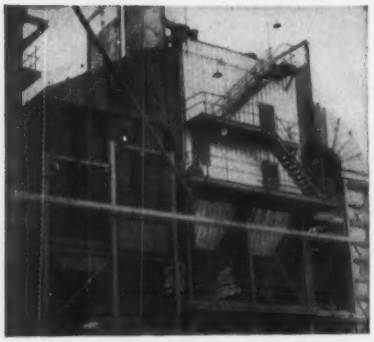


This Cyclone won't clog or plug

Buell's exclusive 'Shave-off' design permits large diameter cyclones that will not clog, plug, or bridge when properly operated: you avoid unnecessary maintenance work or process interruptions.

The unique Shave-off port traps the dust that whirls upward in double-eddy currents, increases cyclone efficiency by eliminating this source of dust reentrainment. Whether installed singly or in groups, Buell Cyclones are the most efficient ever developed.

Other features include extra heavy plate construction for longer service life, Buell-designed manifolds for more efficient, nonturbulent flow of dust-laden gases . . . and the confidence assured by a history of hundreds of installations everywhere in America. Write for a copy of the 12-page booklet, "The Exclusive Buell Cyclone": Dept. 50-I, Buell Engineering Company, Inc., 123 William St., New York 38.



Large-diameter Buell Cyclones in series with Buell 'SF' Electric Precipitator.

buell®

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Reports from the field

Begins on page 190

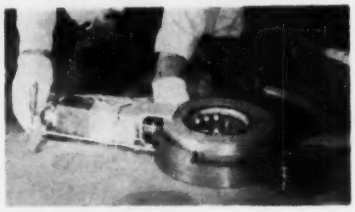
Lightning effects studied in high-voltage transmission

An extensive study of lightning performance will see General Electric Company and Pennsylvania Electric Company cooperating in an experimental 12½-mile 460-kv electric power line to be built in Pennsylvania.

Line will be studied first in model form, with electromagnetic models of towers, conductors and terminal equipment erected in GE's Pittsfield lab, tested with artificial lightning.

The Pennsylvania line will go up in a rugged, mountainous area subject to electrical storms. Area's "isokeraunic level" (a lightning-frequency measurement) is 60% above that of Berkshire County in Massachusetts, where GE is now working on a 4½-mile extra-high-voltage prototype line (see POWER, July 1958, p 93).

Ohio Edison Company plans to adopt transmission at 345 kv, is conducting exhaustive tests. Ohio Edison presently uses 138-kv transmission, but has built a h-v test line to examine conductor movement in wind, ice dropping, cable breaks. So far, no electrical tests have been made on the 1-mile line.



Miniature TV camera reports on fuel elements

Transfer of fuel elements in a nuclear-power reactor can be viewed at close range with a closed-circuit remote-controlled TV system. Previously it took two hours of handling to get element into proper position for observation, but now camera reports on conditions as they happen.

Miniature camera, above, is set atop the loading face shield covering the core of Atomic International's Sodium Reactor Experiment in the Santa Susan Mountains near Los Angeles. Tiny lights inside ring provide illumination for the camera.

For more facts circle 335 on Reader Service card, p 121

Chemical Show—Booth 1002
Coliseum—New York
November 30 - December 4

How B&W JOB-MATCHED STAINLESS PIPE saves time and money in corrosive service

At B&W, you can select the most economical stainless steel pipe for *your* service conditions, because...

- ...the right grade and size is available—seamless or welded.
- ...you get the stainless properties, in the right combination, to simplify bending, forming, and other fabrication operations.
- ...you benefit from B&W's long experience in matching pipe and tubing to process industry applications.

For more information on how you can order B&W Job-Matched Pipe—and B&W Job-Matched Fittings — all from one source, call the tubing specialist at your local B&W District Sales Office. Or write for Bulletin TB-410. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9018-S2

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

FLUIDICS

is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids

FLUIDICS AT WORK

Selecting water treatment systems to meet your specific needs

Many factors are involved in proper selection of water treatment equipment for specific use. Analysis of the raw water, volume and quality of water required, cost of equipment (both initial and operating), amortization rates and plans for future expansion, to cite just a few. The systems illustrated typify answers to widely varying requirements.

If you are concerned with any phase of water conditioning, bring an outline of your requirements to Permutit. As the largest and most experienced producer of water treatment equipment of every type, Permutit can assure you sound recommendations and the most efficient and economical system available for your particular need.

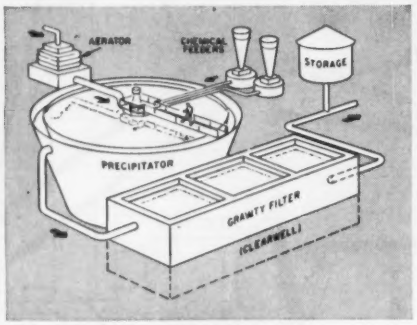
Write to the Permutit Division, Dept. PO-99, 50 West 44th Street, New York 36, New York . . . or Permutit Company of Canada Ltd., 207 Queen's Quay West, Toronto 1, Ontario; or 207 West Hastings Street, Vancouver 3, B. C.

FLUIDICS covers:

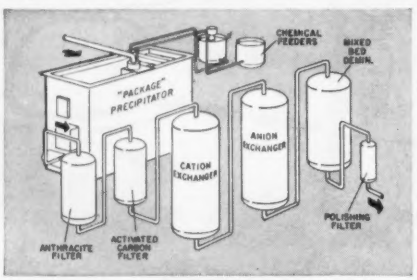
water treatment	
waste treatment	blending
corrosioneering	metering
reactions	piping
fluid analysis	storing
agitation	heat transfer
distillation	centrifuging

PFAUDLER PERMUTIT INC.

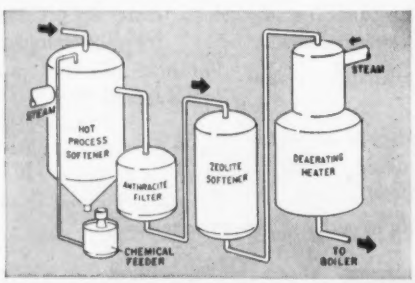
Specialists in FLUIDICS . . .
the science of fluid processes



Well water for municipal supply. Aerator reduces CO_2 to reduce acidity, reduces taste and odor and oxidizes dissolved iron and manganese. Precipitator removes turbidity, color, hardness and oxidized iron and manganese. Gravity filters remove remaining traces of turbidity.



Process water for electronic components. Package Precipitator removes bulk of turbidity, hardness and iron. Anthracite filter removes remaining suspended matter. Activated carbon filter takes out color and absorbs dissolved organics. Demineralizer—cation, anion, and mixed bed—reduces dissolved solids to guaranteed maximum. Polishing filter removes traces of suspended matter.



Water for steam boiler. Hot process softener reduces hardness to a few grains per gallon. Also reduces silica. Anthracite filter removes remaining turbidity. Zeolite softener may be added to system where zero hardness is needed. Finally, the deaerating heater removes oxygen to prevent corrosion.

Appointments

Corporation changes

ACF Industries, W-K-M Div: R O Wynn, vice-president of engineering and research; H C Tooley, vice-president of manufacturing. **Allis-Chalmers Manufacturing Co:** G A Saar, assistant vice-president of industries group. **American Engineering Co:** W C Miles, president. **Boiler Engineering & Supply Co, Inc:** E Emrich Sr, president and chief executive officer.

Bonney Forge and Tool Works: J M Potts, president. **Borg-Warner Corp,** Spring Div: S J Becker, vice-president and chief engineer. **Buell Engineering Company, Inc:** Hugh Mullen, vice-president in charge of operations.

Burndy Corporation: J F Jones, vice-president and director. **Burns and Roe, Inc:** Alexander Matiuk, vice-president of engineering.

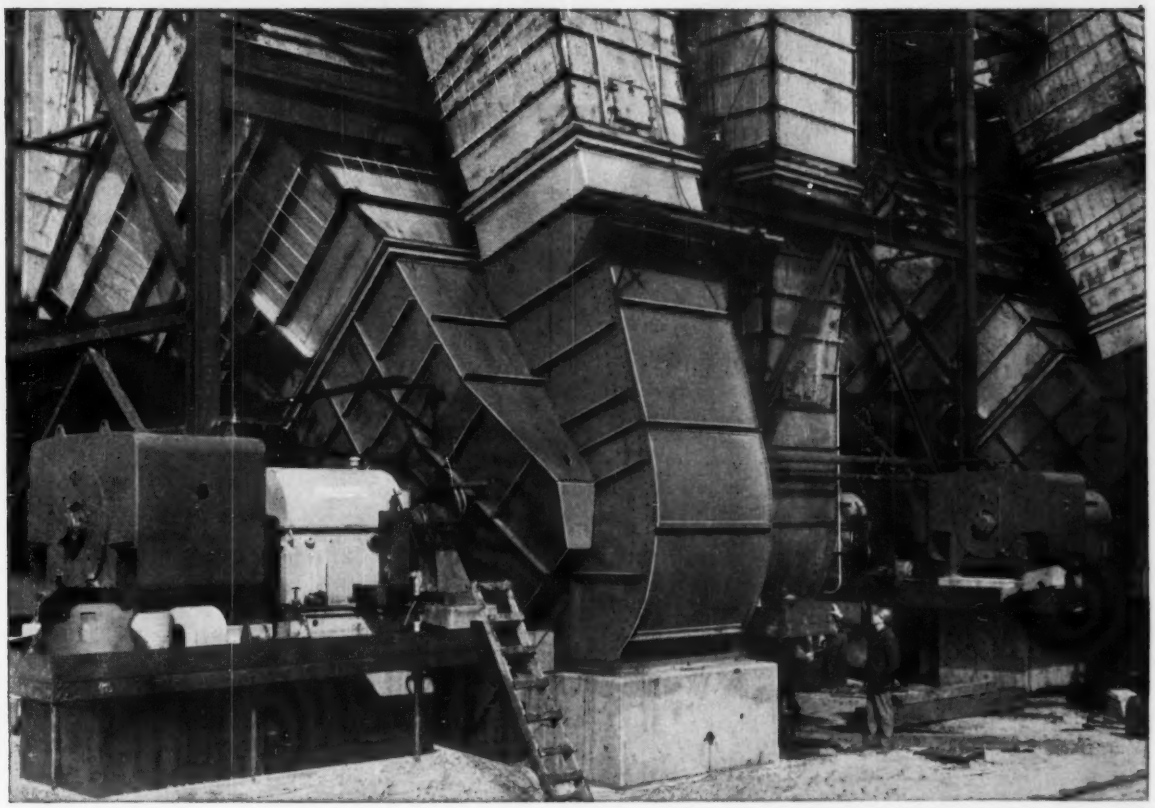
Crane Co: W A Songer, executive vice-president. **Detroit Stoker Co:** H L Wagner, president. **Electric Machinery Manufacturing Co:** A P Burris, president and general manager. **Electric Products Co:** R J Berry, corporate vice-president; J R Williams, vice-president of standard products div; J H Kellogg, vice-president of power-equipment div.

Electric Storage Battery Co: E B Ott, board chairman; E J Dwyer, president. **Leeds & Northrup Co:** C R Cary, board chairman; D H Schultz, senior vice-president; G E Beggs Jr, executive vice-president.

Pleasantville Instrument Co: J F Price, vice-president of operations. **Stone & Webster Engineering Corporation:** H F Cleary, D N McCord, M H Cutler, W R Prang—vice-presidents.

Swartwout Co: J D Weber, vice-president and manager of Autronic Control Div. **Terry Steam Turbine Company:** A L Thomson, president and treasurer. **Thayer Scale Corp:** J O Peterson, vice-president.

Western Precipitation Corp: A W Knight, president. **Wilson Rubber Company:** J W Simmons, president. **Worthington Corporation:** G F Habach, vice-president of administration; A G Mumma, vice-president of engineering.



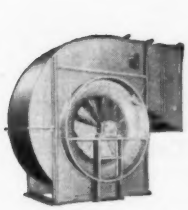
HOW DO YOU SELECT MECHANICAL DRAFT FANS?

By price alone? Undoubtedly not because proper fan performance cannot be obtained by cut-rate methods. It must be engineered and built to a standard, not a price.

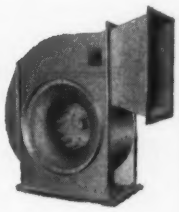
"Buffalo" Mechanical Draft Fans are built to an engineering standard with over 80 years experience and hundreds of installations to back it up. This engineering experience combined with "Q" Factor* construction makes the complete line of "Buffalo" Mechanical Draft Fans a best buy in the long run.

Be sure to phone your "Buffalo" Engineering Representative when you want reliable, high efficiency, long life mechanical draft fans.

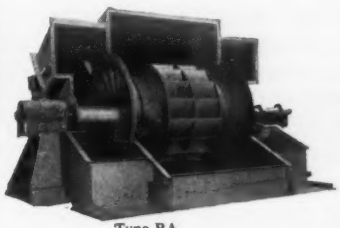
*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.



Type CR
Radial Blade Fan.



Type BLH
Backward Curve Fan.



Type BA
Airfoil Fan.

"Buffalo"

BUFFALO FORGE COMPANY

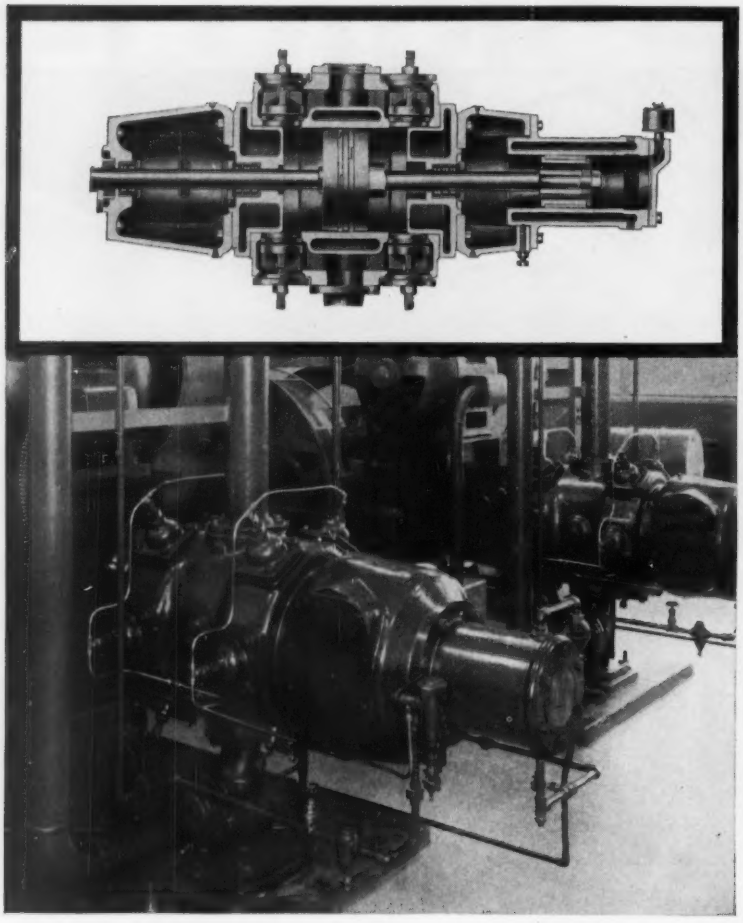
Buffalo, New York

Buffalo Pumps Division • Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

For more facts circle 338 on Reader Service card, p 121



*with PENNSYLVANIA tailrod construction,

COMPRESSORS PROVIDE GUARANTEED OIL-FREE AIR...eliminate contamination

If your processes stand the chance of being ruined by the least contamination, better look into Pennsylvania Oilfre Compressors today. They are built specifically to eliminate any lubricant or oily vapor which would interfere with delicate instruments, contaminate food and beverages or be incompatible with chemical processes.

*Pennsylvania Oilfre construction is one reason that we can guarantee oil-free compressed air or gas. An extra long distance piece between compressing cylinder and main frame assures that no part of the piston rod which enters the lubricated frame will alternately enter cylinder stuffing box. Result: a compressor with isolated cylinder which will deliver air or gas guaranteed entirely free of oil or oily vapors due to lubricants. Pennsylvania tailrod construction produces a full floating piston which prolongs the life of carbon piston rings and eliminates the danger of piston riding against cylinder walls.

Get full details on Pennsylvania 3-ATC Compressors. Send for free copy of Bulletin 351, today.

PENNSYLVANIA PUMP AND COMPRESSOR CO.

Easton, Pa. • Earning customer confidence since 1920

Appointments

Begins on page 198

Operations changes

Allis - Chalmers Manufacturing Co: W H Davis, manager of electrical dept, Norwood (Ohio) Works. **Babcock & Wilcox Company:** G W Kross Jr, assistant manager of tubing operations, Tubular Products Div; Robert A Barr, general manager, Refractories Div. **Burndy Corp:** L M Lyons, production manager, Utility Industrial Div. **Carpenter Steel Company,** Alloy Tube Div: J S Kline, general manager. **Computer Systems, Inc:** T J Kusto, director of research.

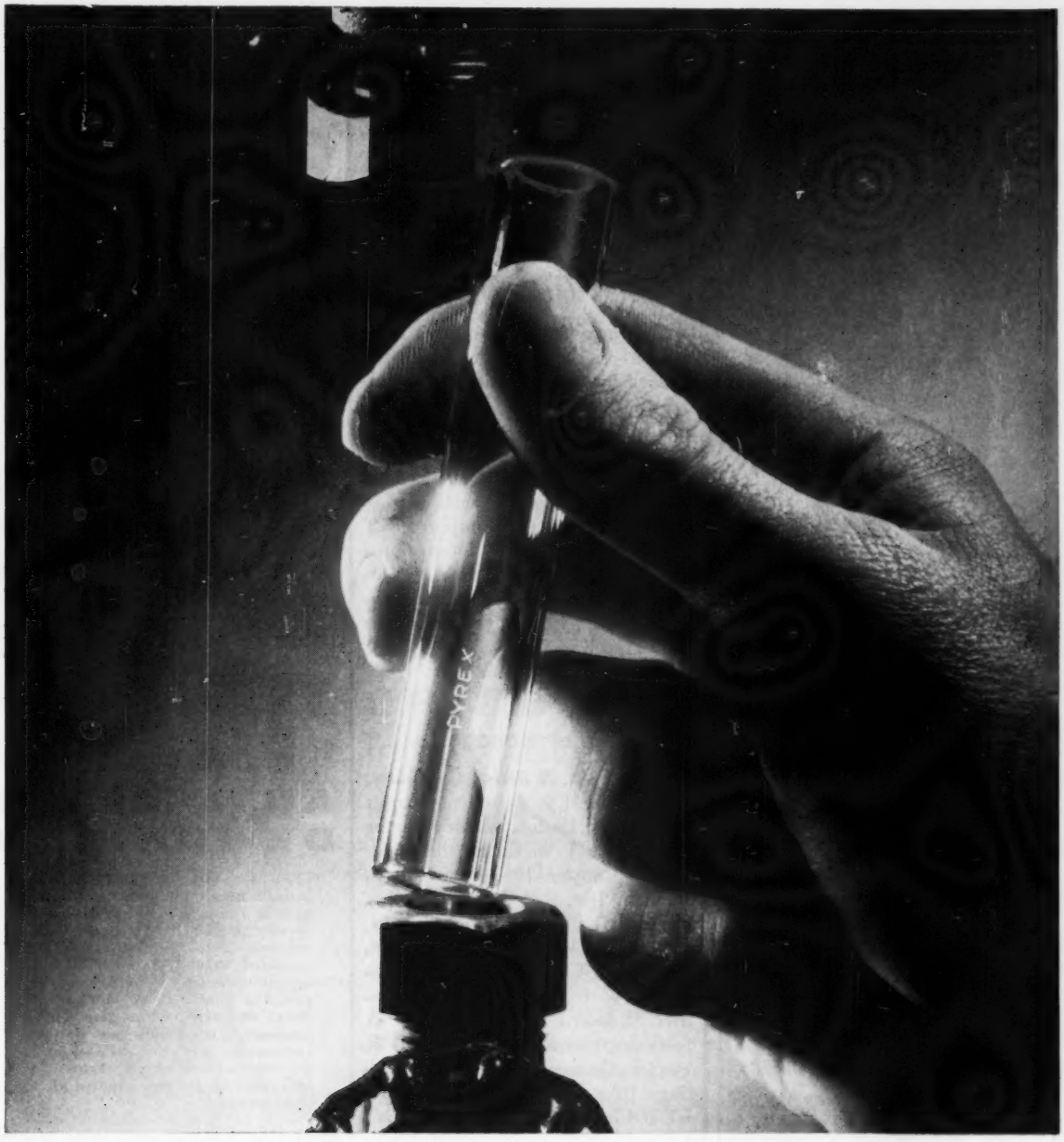
Cummins Engine Company, Inc: W A Reeks, managing director of Cummins Diesel International Ltd. **De Laval Steam Turbine Co:** P S Nurko, works manager. **Endevco Corporation:** J L Higgins, manager of technical services. **General Electric Company:** R C Allen, manager of engineering.

Keasbey & Mattison Company: S J Ostrowski, engineering coordinator. **Minneapolis - Honeywell Regulator Co:** K C Cummings, manager of engineering. **Nalco Chemical Company:** Dr D G Braithwaite, commercial development head; E C Crocker, manager of applied research and development; D G Blake, plant manager.

Philadelphia Electric Company: E W Carson, service-operations manager. **SKF Industries, Inc:** F E Whyte, director of purchasing. **United States Rubber:** J J Cullen, product manager. **Walworth Company:** John Alico, director of engineering. **West Penn Power Company:** J W Geiser, asst manager of research and development.

Engineer changes

Air - Conditioning and Refrigeration Institute: M R Martin, assitant engineer. **Allis - Chalmers Manufacturing Company:** E S Evans, assistant chief engineer, Steam Turbine Dept. **Computer Systems, Inc:** M M Gerber, chief engineer. **Endevco Corporation:** E E Eller, Instrument Design Engineer—Ceramics Dept. **Fischer & Porter Co:** A R Hughes, special-projects engi-



A gauge glass installed...and two more on the shelf

Make short work of gauge glass replacement—when the replacement is as near as your stockroom shelves. You'll cut down time.

Take *three* gauge glasses the next time you order from your distributor. That gives you *one* for the gauge right away, a *second* for regular replacement, a *third* to cover special emergencies.

And here's another tip—don't rely on any old type gauge glass. Insist on regular replacement with PYREX®, CORNING®, or MACBETH® to avoid trouble.

These gauge glasses last longer—because they're harder to break! They stand up better to just about every clouding hazard. They easily resist high temperatures and high pressures.

One of these brands is just right for your gauge. Get some from your regular mill supply dealer. And remember—ask for *three* for each gauge!

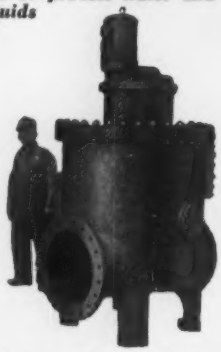
(Corning makes sight glasses, too—from tough PYREX brand glass. Use them whenever you must see what's going on inside your processing equipment. Your distributor has them.)

Corning means research in Glass

CORNING GLASS WORKS, Corning, N. Y.

For more facts circle 340 on Reader Service card, p 121

More clean water at a lower cost with
S.P. KINNEY AUTOMATIC SELF-CLEANING
STRAINERS
. . . for efficient removal and disposal of suspended particles from raw or process water and other liquids



✓ Over 1000 installations
✓ 2" to 48" pipeline sizes
✓ Installation on pressure or suction side of pump

Write today for Bulletin 500.1P

S. P. KINNEY ENGINEERS, Inc.
CARNEGIE, PENNSYLVANIA

circle 341 on Reader Service card, p 121

Snapit-On
Protector Shields for CONDENSER AND BOILER TUBES

DETERS EROSION
PREVENTS MATERIAL WASTAGE
REDUCES MAINTENANCE
GIVES TUBES LONGER LIFE
MADE IN STAINLESS STEEL AVAILABLE IN ALL SIZES

The Vince BASNIK Company
2020 Lenier Street • Cleveland 13, Ohio

Appointments

Begins on page 198

neer. **Kerr Atkinson:** J K Pearson, steam and power dept; E H Barry. **Yardney Electric Corp:** Stanley Fried, applications engineering dept. **Youngstown Sheet and Tube Co:** P L Arnold, service engineer.

General sales manager

Armstrong Cork Company: W M Martin, assistant manager, Industrial Div. **Electric Machinery Manufacturing Co:** H W Forschner, general sales manager. **Englehard Industries,** American Platinum & Silver Div: Joseph Nickerson, coordinator of electrical-contact sales.

Johnson Service Company: S T Hagerman, manager — International Div. **Pfaudler Permutit Inc:** Morris Wolfe, manager—chemical sales and service. **Planet Corporation:** R E French, general sales manager; R S Miller, assistant manager.

District sales manager

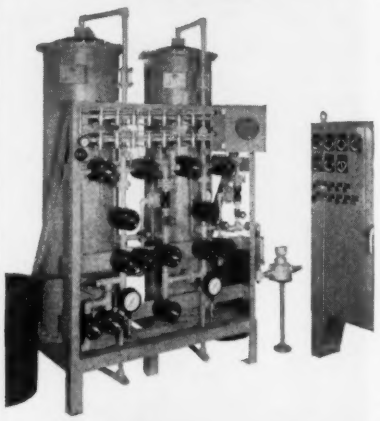
Babcock & Wilcox Company, Boiler Div: R K Behr, New York; G S White, Boston. **Bailey Meter Company:** J W Cunningham, Atlanta. **Cooper-Bessemer Corp,** Domestic Div: R W P Johnson, New York; E D Van Fossen, western district; R L Moore, eastern district.

Crosby Valve and Gage Company: W E Mikolasy, eastern district. **Edward Valves, Inc:** R A Seethaler, central sales region. **H K Porter Company,** Forge and Fittings Div: A A Kascak Jr, Tulsa. **I-T-E Circuit Breaker Company:** J J Sedlacek, Philadelphia. **Moloney Electric Company:** L R Hurley, Narberth, Pa.

Ohio Brass Company: J J Langan, Mid-Atlantic states. **Ohio Injector Company:** C G Link, eastern region; R F Dauenhauer, western region. **Okonite Company:** S R Howard, Los Angeles; D J O'Connor, Tulsa, Okla; J F Angle, Salt Lake City. **Fibreboard Paper Products Corporation,** Pabco Industrial Insulations Div: G B Henderson, southern mid-continent.

Parker-Hannifin Corporation: R N Boucher, manager of distributor sales, Philadelphia. **Republic Manufacturing Company:** R J

SET IT DOWN!
HOOK IT UP!
ILLCO-WAY ionXchange EQUIPMENT



COMPLETE AUTOMATIC DE-IONIZER

Here is a complete, loaded, fully-instrumented, *automatic* ionXchange unit in a neat, compact, and *ready-to-operate* "package." It is equipped with our own Illco/Matic, all-plastic, air-actuated valves, which have been specially developed for ionXchange service. The Control Panel, also our own design and manufacture, provides all necessary quick-adjustment features, and requires only electrical hook-up to the terminal box on the frame. The only other connections required are to plant service.

FULLY ASSEMBLED AND READY TO INSTALL

All structural assembly of elements, all piping, all wiring, and all installation of air lines is done in our factory by men of long experience. Then the unit is tested for proper operation of all circuits, loaded with the proper supporting beds and resins, painted, bolted to a skid, and crated for delivery to the exact spot it will be used. *This is the quickest, easiest, and surest way for you to get a reliable, ready-to-go ionXchanger* — arranged and instrumented to suit your special needs, whatever they are.

Write for Particulars

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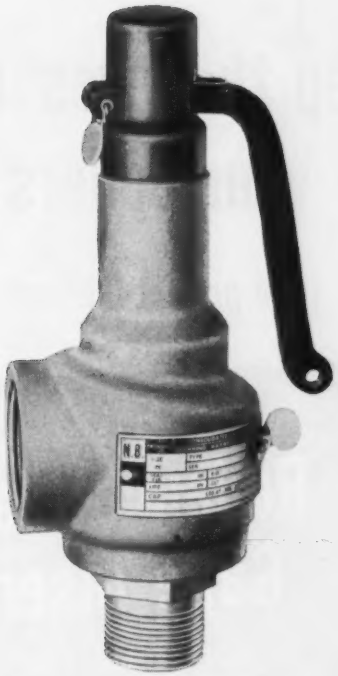
ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Can.

circle 343 on Reader Service card, p 121



NEW
high capacity
BRONZE PORTABLE VALVES
reduce initial valve cost

Consolidated Safety Valve Type 1540 Series. Sizes: ½" thru 2½". Pressures to 250 psi. Temperatures to 406°F. Available with side or top outlet.

These new Consolidated Safety Valves are specifically designed for such applications as package-type steam generators, fire tube boilers, and air compressors. High-capacity design reduces the size and/or number of safety valves required.

You can be sure of stable performance and uniform blowdown control. These bronze portable valves have a precision-wound, calibrated spring aligned with cone-shaped spring washer bearings. The integral combination adjusting ring and disc guide are double guided. Alignment is better, blowdown adjustment is easier, operations finer. Positive tightness is certain: the seat is machine lapped to optical flatness. Opening is sharp and clean, without simmer. Lifting lever is fully adjustable over more than 300°.

When a lower capacity rating is adequate, you can choose valves in medium capacity to conform closely to actual capacity requirements. Capacities, sizes and descriptions of new Consolidated Bronze Portable Safety Valves are given in Bulletin 740. Write for a copy.

Industrial distributors in all principal cities backed by convenient regional warehouses are ready to serve you.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

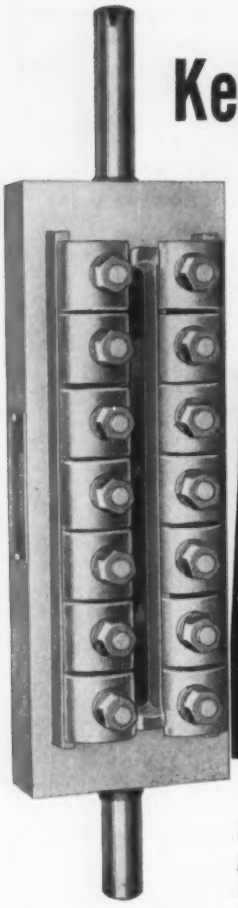
MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 344 on Reader Service card, p 121

Keep the "eyes" of your boilers safe

... to protect life and property



Use

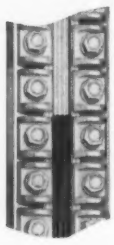
Reliance Water Gage Inserts

for leak-tight shatter-proof service

New Reliance Mica-protected Flat Glass Gage Insert for steam pressures to 1500 psi. Rigid wide body; improved Reliance finger-type clamping principle.

It's false economy to "scrimp" on water gages. These vital basic checks on water levels should be of highest quality, assuring continuous clear reading, and safety for workers and equipment . . . A few hints worth considering:

1. See that you have gage inserts on all boilers and supplementary vessels corresponding with the design pressure.
2. Insist on frequent inspections and maintenance to *prevent* trouble.
3. Keep spare inserts and replacement parts on hand for prompt use when needed. (Many plants use spare inserts when necessary to keep gages in continuous service — make repairs when convenient.)



Reliance PRISMATIC Gage Insert shows sharp black-white contrast between water and steam. Models for pressures to 350 psi.

Reliance, oldest manufacturer *specializing* in boiler safety equipment, makes water gage components for all pressures, any visibility range. Also direct-to-drum assemblies. Extra strength — a generous margin of safety — is built into all Reliance products. When you write, please mention your working pressure.

The Reliance Gauge Column Co.
5902 Carnegie Avenue • Cleveland 3, Ohio

BOILER SAFETY DEVICES

Reliance®

1884 75th YEAR 1959

Appointments

Begins on page 198

Fournier, New England and metropolitan New York. **Stephens-Adamson Manufacturing Company:** P A Christopher, Los Angeles. **Sylvania Electric Products Inc:** G W Ross, Milwaukee. **Taylor Fibre Company:** D R Robertson, New York; E J Guelpa, California. **Walworth Company:** J E Walsh, metropolitan New York.

Recent purchases, mergers

Ehret Magnesia Manufacturing Co and **Baldwin-Hill Company** have merged. The new company, known as **Baldwin-Ehret-Hill, Inc** will have home offices located at 500 Breunig Ave, Trenton, N. J. New company manufactures industrial and home insulations covering a temperature range from –460 F to 2000 F and acoustical products.

Institute elections

American Society of Mechanical Engineers: W L Cisler, president; W C Heath, D E Marlowe, H N Muller Jr, C H Coogan—vice presidents. **American Society of Heating, Refrigeration and Air-Conditioning Engineers:** R C Cross, executive secretary.

Retirements

R G Lockett, I-T-E Circuit Breaker Company, western regional sales manager, after more than 22 years of service. **J D Stout,** president and treasurer of Terry Steam Turbine Company, after more than 50 years.

Obituaries

Martin Frisch, vice-president and director of advanced engineering, Foster Wheeler Corporation, on June 16th.

Carlton B Smith, director of services, Allis-Chalmers Industries Group, on July 6th.

George A Stetson, editor emeritus, American Society of Mechanical Engineers, on June 20th.

Elmer R Tieberman, retired sales executive, Lunkenheimer Company, on June 24th.

Hugo W Wahlquist, corrosion-engineering consultant, Ebasco Services Incorporated, on July 9th.

"Did you look in D.J.'s locker for my P.F.I. STANDARDS?"

SEND COUPON BELOW FOR THESE P. F. I. STANDARDS

1 Machining Backing Rings for Butt Welds
2 Dimensioning Welded Assemblies
3 Linear Tolerances Bending Radii
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6 Built-up Weld, Metal Bosses
7 Welded Nozzles—Spacing
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10 Stress Relieving Practices

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THE PIPE FABRICATION INSTITUTE

There's no need to look "high and low" for missing P.F.I. Standards, you simply mail the coupon below for the copies wanted.

Listed at the left are ten technical bulletins that are proving their usefulness to many engineers.

These P.F.I. Standards are packed with vital data on the design, the fabrication and erection of high pressure and high temperature piping used by all industry. However, these technical bulletins do not explain the many advantages of shop fabrication.

Remember, shop fabrication by the companies responsible for the development of P.F.I. Standards is your only real assurance of meeting the most exacting requirements of piping, whether it's welded, bent, coiled or vanstoned . . . in any metal as a component or a complete assembly. Write for all ten P.F.I. Standards or indicate in the coupon below which ones could be helpful to you.

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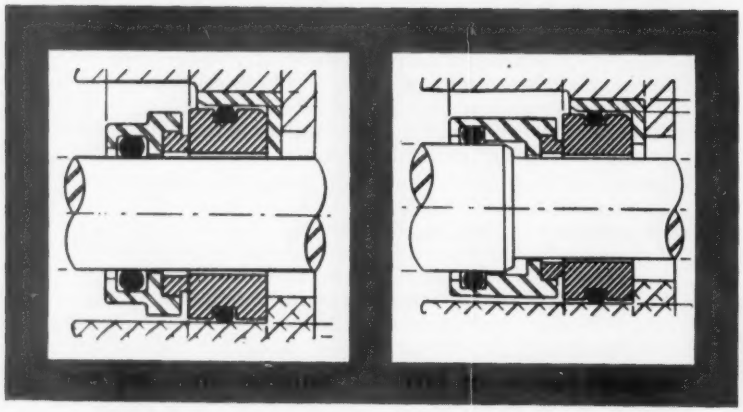
REVOLUTIONARY NEW SEAL

CHESTERTON SPRINGLESS SEAL

ELIMINATES:
Springs
Set Screws
Spring Stops

Requires only 2 parts and two O-rings

First basic improvement in Mechanical Seals in 35 years



SIMPLE TO INSTALL — Self positioning — Does not require dismantling of pump. Magnetic attraction of sealing and mating rings eliminates use of springs. Up to 18 parts eliminated. Sealing contacts always positive and even. Seal is so thin it will fit in shallowest of boxes.

Complete brochure gladly furnished on request.

A. W. CHESTERTON CO.
7 ASHLAND ST., EVERETT 49, MASS.

America's Oldest Manufacturer of Mechanical Packings

Bookshelf

Maintenance Hints. *650 pp, 5x7, leatherette, $2.00. Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa.*

Handbook is designed to provide a quick, convenient guide to modern maintenance practices on all types of electrical equipment. The first 17 chapters cover maintenance of specific apparatus, last seven cover general maintenance of materials such as insulation.

In this revised manual, all chapters have been updated. A new chapter covers the maintenance of static controls and the sections on electronics and electric brakes have been altered and enlarged.

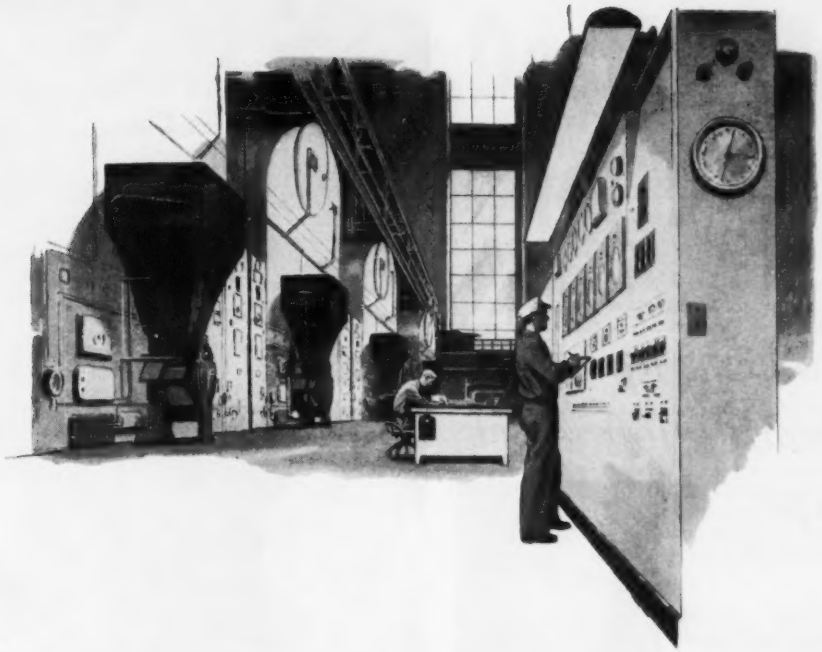
Corrosion and deposits in boilers and gas turbines, *a report of ASME research committee on corrosion and deposits from combustion gases. 198 pp. Research publication of American Society of Mechanical Engineers, 29 W 39th St, New York 18, N. Y. $4.80 to members, $6.00 to non-members.*

Objectives of this report are twofold:

(1) Present a critical summary of all available information concerning factors influencing deposits of solids and causing corrosion on the gas side of boilers and gas turbines.

(2) Define further research needed to increase knowledge of deposition and corrosion.

First of the seven chapters covers the mineral makeup of coal and oil and the behavior of these constituents during combustion. Chapter two devotes space to SO_2 and SO_3. Third chapter goes into the purely physical aspects of deposition—the actions of particles in a gas stream that may bring them close enough to a surface to be captured. Chapter four presents what is known about the origin and composition of deposits, and looks at methods of minimizing them. Fifth and sixth sections cover corrosion effects of both high- and low- (below 400 F) temperature gases. Last chapter discusses removal of solids from combustion gases ahead of turbines and air heaters.



We've helped a lot of companies cut cost per 1000 lbs. of steam!

Over the years we've helped many companies achieve greater efficiency from their equipment and cut production costs per 1,000 lbs. of steam.

In many cases, the wrong type or grade of coal had prevented these companies from achieving maximum economy. If you feel that your steam costs are high, contact one of the Norfolk and Western coal bureaus listed on this page. Our coal engineers will check with you on your boilers, stokers, and other equipment, then recommend coal with the exact physical, chemical and burning characteristics to give you best results.

Of the many top-quality coals mined along the lines of the Norfolk and Western, there is one that ideally suits your needs. Mined, prepared and transported by the most up-to-date methods, these coals have aptly been termed "Fuel Satisfaction." Find out how they may be able to cut your fuel costs. Contact one of our coal bureaus today.

Write, wire or call one of these
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N&W Coal Traffic Dept.
Telephone Diamond 4-1451
Ext. 3313, 423, 3249, 3732
Roanoke, Virginia

BOSTON
833 Chamber of Commerce Building
Telephone Liberty 2-2229
Boston 10, Massachusetts

CHICAGO
660-664 Marquette Building
140 S. Dearborn Street
Telephone RAndolph 6-4634
Chicago 3, Illinois

CINCINNATI
913 Dixie Terminal Building
Telephone DUnbar 1-1325
Cincinnati 2, Ohio

CLEVELAND
Room 722,
The Illuminating Building
Telephone MAin 1-7960
Cleveland 13, Ohio

DETROIT
1514 Book Building
Telephone
WOodward 1-2340 or 1-2341
Detroit 26, Michigan

ST. LOUIS
2059 Railway Exchange Building
Telephone MAin 1-1180
St. Louis 1, Missouri

WINSTON-SALEM
1105 Reynolds Building
Telephone PArk 2-7116
Winston-Salem 1, North Carolina

Norfolk and Western
RAILWAY
CARRIER OF FUEL SATISFACTION

For more facts circle 348 on Reader Service card, p 121

How many spare parts should you stock per pump?

"You may be *over*stocking," says Phil Olmstead, *Chief Engineer*, Goulds Pumps, Inc.

"There are many times," one plant manager told me recently, "when we have a *higher* inventory of spare parts than the people we buy from!"

No laughing matter, this—many plants today are faced with the difficult problem of keeping stocks *adequate*, yet keeping inventories *down*. If your problem is *pump parts*, you can do both—by *interchangeability!*

For instance, take the Goulds Fig. 3405 single-stage centrifugal. You can get it in 33 sizes, with 66 combinations possible, considering right- and left-hand rotation. *Just 3 groups of parts fit all 66 combinations of this pump!*

That means that, for every three to five pumps of a given group size (sizes are divided up three ways into "small," "medium," and "large" groups), we can recommend that you stock just one shaft, one set of bearings, sleeves, mechanical seals or packing. *In short, all parts are interchangeable except casings, casing covers and impellers!*

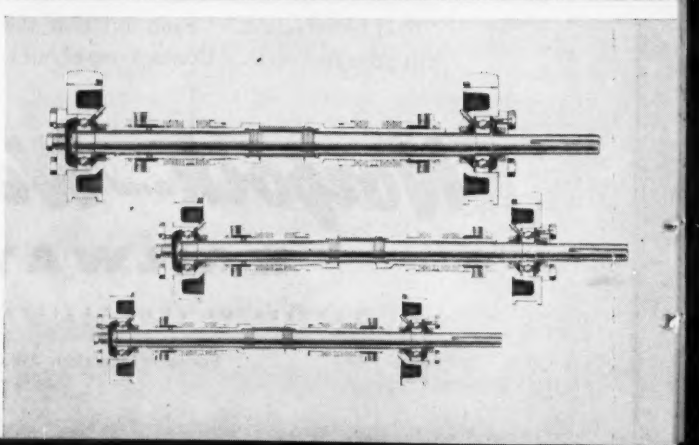
How much can that cut down your inventories? You figure it out—*one* set of group parts for as many as *five* pumps, where you might expect to stock one for each. *Three* groups for *thirty-three* different sizes of pumps—a *91% cutdown!*

And here are three more advantages to consider:

1. You can make changes *in the field* to meet new needs.
2. You receive off-the-shelf delivery of parts you order.
3. Initial cost is lower due to standardization in manufacture.

The next time you talk to a Goulds representative, ask him to show you how interchangeability works in our Fig. 3405 . . . and in the rest of our line, too. If you want information right away, drop a line to me, Phil Olmstead, at Goulds Pumps, Inc., c/o Dept. PO-99, Seneca Falls, N.Y. I'll see that you get all the information you want.

GOULDS GP PUMPS



Just three groups of shafts, sleeves, bushings, glands, packing, ball bearings, bearing shell, end caps, closures and gaskets for Goulds Fig. 3405 pump to fit all 33 pump sizes.

Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3" to 72" made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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BADGER S·R EXPANSION JOINTS

◀ circle 349 on Reader Service card, p 121

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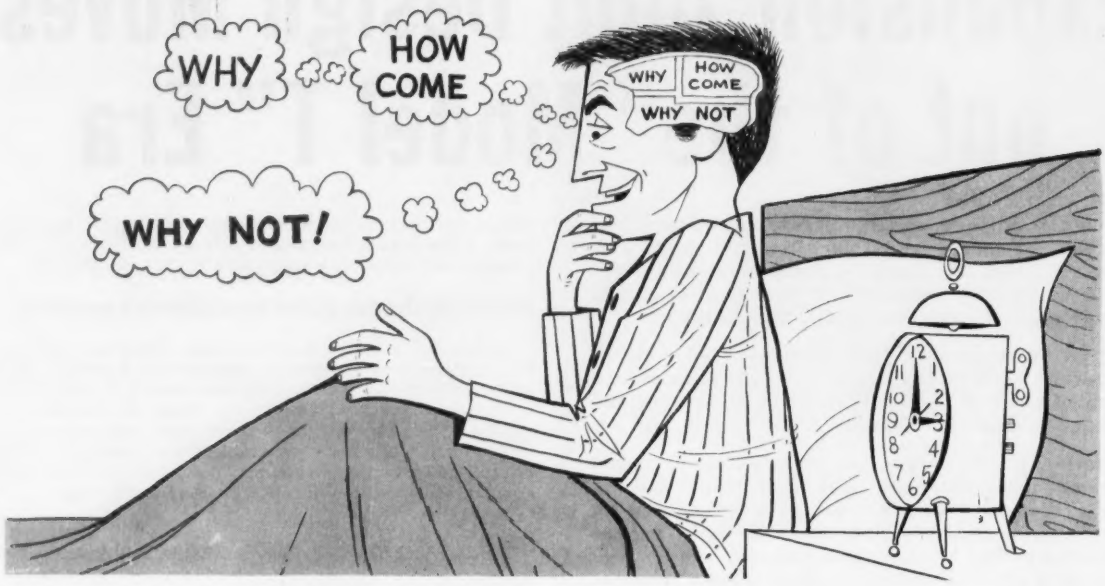

George Edwards

asks: "*Must* whatever goes up come down???"

When England's Roger Bannister broke the 4-minute-mile barrier in May 1954 he threw the sports world into a tizzy. Until that electrifying day the thought of running a mile in four minutes flat was enough to leave a guy breathless. "Too tough for a human being," was the consensus.

Asked by Arthur Daley, able sportswriter for the *New York Times*, if he thought any other would be able to duplicate the feat, Bannister's opinion was that there'd be a "deluge." Why? "Because I thought it was mostly a psychological barrier I had broken," he said.

How right he was. Since Bannister proved it *could* be done, the "impossible" 4-minute barrier has been breached some 50 times. Now there's no denying that running a mile in four minutes takes some doing from a physical standpoint. But Bannister put the importance of *mental* approach into sharp focus.

This psychological-block business may have us buffaloed without our knowing it. We've all heard the classic about aerodynamic "proof" that the bumblebee can't fly. Think what this might have meant to bumblebees had they been steeped in the "it can't be done" propaganda. Would there ever have been a "bumblebee Kitty Hawk"?

It's probably true that we don't build our psychological barriers as much as we let them form in front of us. Almost two hundred years ago Tom Paine said, in effect, that colonial progress wouldn't get to first base if everybody was content to sit back and do things the way they had been done for centuries in Europe. We've come a long way, we know, but less than six months ago a prominent industrialist complained, "Too many people are content to follow a routine instead of trying to come up with better ways of doing things."

I think that both Tom Paine and our contemporary industrialist were a little on the pessimistic side, but they do make a point. It isn't that most of us believe that better methods are impossible. Truth is we don't think about it much one way or the other. We're prone to accept what we've been taught as "fact" and let it go at that. And so we let the barrier build itself in front of us.

Coming through such a barrier is peanuts compared to Bannister's effort. All we have to do is let our minds spend some time on "why" and "how come," and gradually shift to "why not?"

For what purpose? Du Pont's president, Crawford H Greenewalt, put it this way in an address to the American Newspaper Publishers' Association:

"Behind every advance of the human race is a germ of creation growing in the mind of some lone individual; an individual whose dreams awaken him in the night while others lie contentedly asleep. We need those dreams, for today's dreams represent tomorrow's realities."

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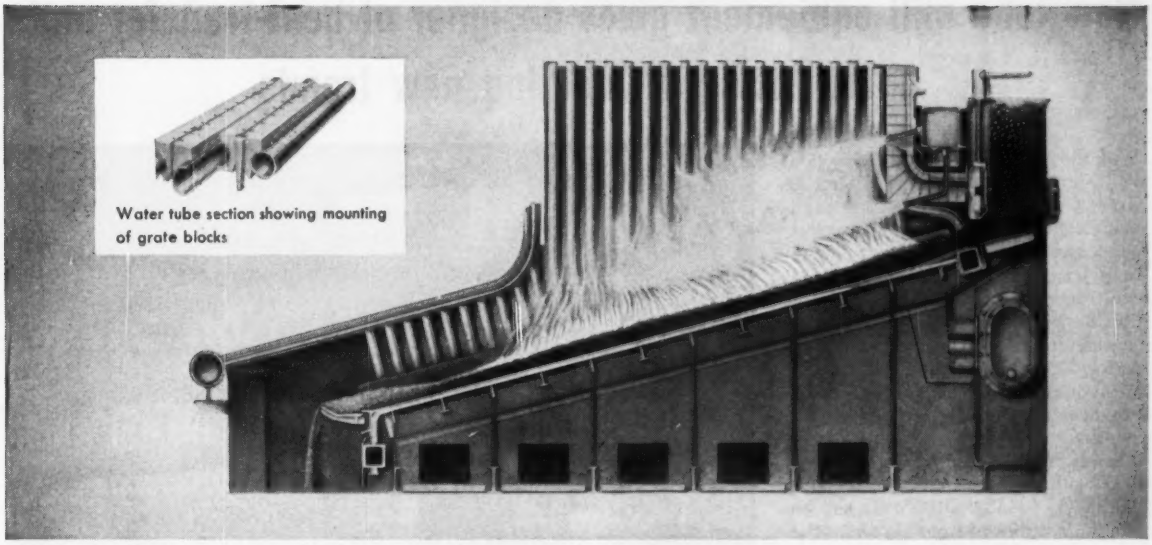
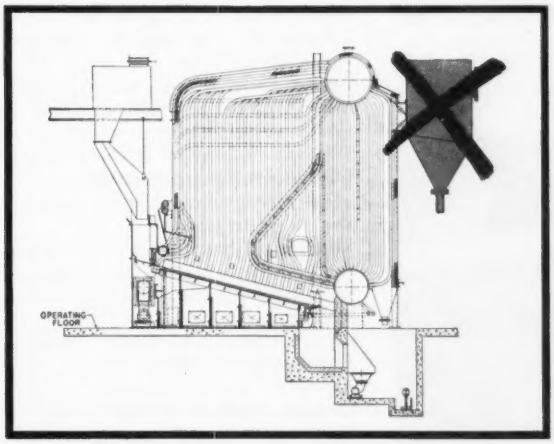


Water-cooled grates. Water-cooling . . . directly connected to the boiler circulation system . . . guarantees the longest grate life available in any stoker today. Proven maintenance costs are less than one cent per ton of coal. In fact, one major installation has used less than $200.00 worth of repair parts in over four years of continuous operation!



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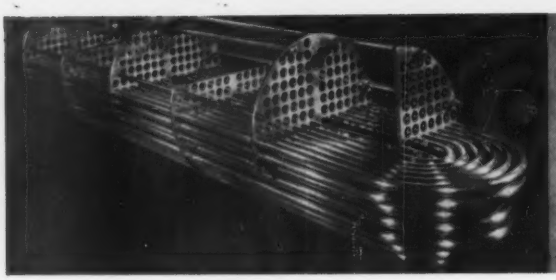


CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, New York

New tube mill equipment gives designer of heat-transfer units freer hand in meeting new trends

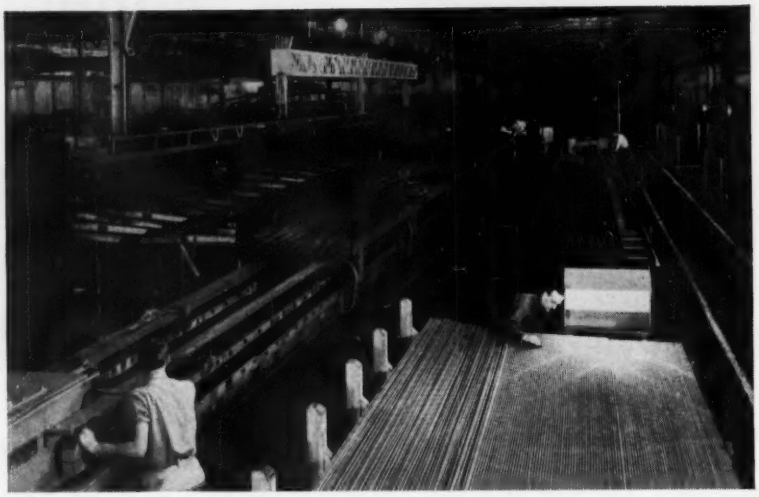
With the installation of new production and testing equipment, The American Brass Company now offers the most complete service available to users of condenser and heat exchanger tubes.

Long lengths. To gain advantages in construction, processing, or installation, designers can lengthen equipment considerably. Tubes can now be drawn up to 100 feet. Most of the longer tubes are required as U-bends, but in some instances may be shipped as straight lengths.

U-bends. Tubes from ⅜″ O.D. to 1½″ O.D. with wall thicknesses from .049″ (18BWG) to .134″ (10BWG) can be bent on a radius of from 1¼ times the tube O.D. to 30″.

Dual Gage. Where high temperatures and pressures are involved, it may be desirable to thicken the tube wall in the area of short-radius bends on U-bend tubes. Walls are thickened one Stubs' Gage No. to compensate for thinning of metal in the bending.

Thickened Tube Ends. To compensate for thinning by rolling or by impingement corrosion caused by high velocities, tubes may be supplied with the wall thickened at one end one or more Stubs' Gage Nos. The extra thickness may be on the outside or inside of the tube as required.



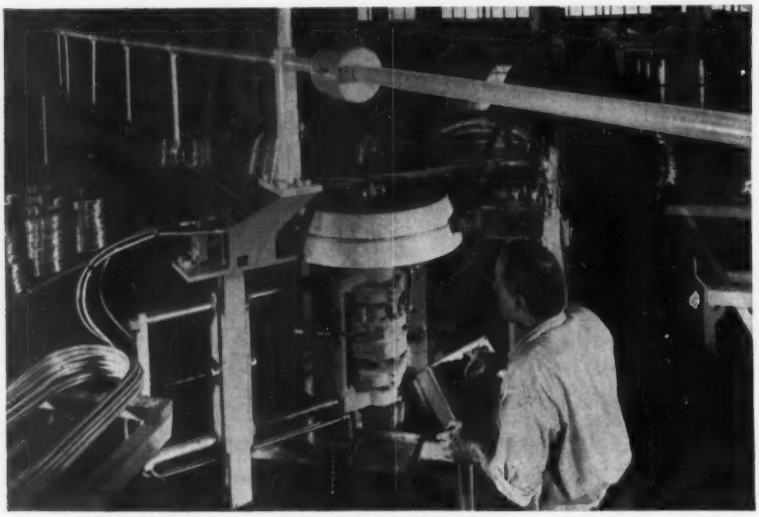
GENERAL VIEW of new American Brass Company equipment which can draw copper and copper alloy tubes in lengths up to 100 feet.

Relieving Stresses. All U-bend tubes, other than copper, are annealed at the bend area after bending, to eliminate the hazard of stress-corrosion cracking which might occur in service due to stresses that may exist as a result of the bending.

Testing. U-bends are tested hydrostatically at ASTM Specification pressures —or at ASME Code pressures up to 6000 psi on request, if the tube size will stand it. Electronic inspection with eddy-current equipment is available also, when required.

Shipping. U-bend tubes are shipped packed for ease in handling and storage.

Technical Assistance. For more detailed information on extra-long tubes, U-bend, Dual-gage, or Duplex tubes to meet special problems, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ont. 5057 Rev.



BENDER CAN produce U-bend tubes with straight leg up to 50′ long.

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TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

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STEVE ELONKA
Associate Editor in Charge

By L E STEWART
Assistant Editor

MODERN LEAK DETECTOR helps this power man locate minute piping leaks which can seriously affect operation of any large refrigerant, high vacuum or gas-filled system

Refrigerant leaks can shut down your process coolers, or leakage into high-vacuum systems ruin product. To help handle these problems here's latest data on . . .

How to spot costly system leaks

Finding leaks in power-service systems can be a time-consuming task, particularly in the area of refrigeration and air conditioning. In this article POWER brings you a roundup of leak-detecting methods to help you trim maintenance costs and to show where this important field has a place in your plant operating plans. We'll look at old techniques brought up to date, and new techniques now in use or gaining acceptance.

Application of leak detectors to various power services is first of all a question of economics. What is the least-expensive way to get desired results? Answer varies with size of equipment tested and accuracy required. Hydrostatic tests of steam generators or hydraulic systems will indicate significant leaks by a drop in pressure and by liquid accumulations in the area of the leaks. However, static pressure test of a large industrial refrigerating system would be too insensitive to spot serious leaks of refrigerant gas.

In general, this means the power-service man will be looking for leaks of cu ft per min in his boiler casing, and possibly his air ducts. At the same time he must locate refrigerant gas leaks of 0.1 oz per year, and if process needs include special vacuum or contaminant systems, leaks as small as one cc in 3000 years.

Pressure testing for leaks is an important part of pressure-vessel construction and repair. Relative incompressibility of liquids produces noticeable drop in pressure for even small leaks. Leak detection in hydraulic systems which operate under vacuum is another story. An oil-pump suction line is often erroneously tested hydrostatically when any actual operating leaks would be of air entering the system. In this case an air static test is preferable since systems appearing tight under hydrostatic test often leak when filled with air and given a soap-bubble test.

With boiler furnaces under draft, air ducts etc a certain amount of leakage can be tolerated. Air leakage represents increased operating costs in the form of extra fan power. When such a system can be shut down for inspection, smoke-bomb tests locate major leaks. Minor leaks can best be spotted by candling the unit. This operation works equally well for pressurized or draft units and can be carried out with the system in service.

Normally leak testing to greater accuracy than candling

is not warranted since leaks of such small magnitude would not measurably increase fan-power requirements of any sizable system.

Where leakage involves toxic or corrosive gas and fumes candling will not be sensitive enough. Under these circumstances bubble tests or more sensitive tests used with refrigerants will help.

Modified soap test is still good

Just about every power engineer has resorted to soap-testing pipe joints at one time or another. Used in conjunction with static air-pressure tests, soap solution applied to suspected areas bubbles up at any point of leakage. Biggest limitation to this technique has been its relative insensitivity to small leaks. Proper maintenance of refrigeration systems requires you to spot leaks as small as ½ oz per year—well beyond the sensitivity of a standard soap test. For this application newer methods show up.

Today, "soap" testing usually employs commercially prepared solutions which have high film coefficients. Often marketed in aerosol cans, modern solutions are easier to use and are far more sensitive. (See *How To,* POWER, July 1958.)

Further development in solutions has a big application in the refrigeration and air-conditioning field. A family of chemical indicators now available changes color in the presence of certain gases. Halogen-sensitive fluid applied to a pipe joint discolors if a refrigerant leak exists. Basic limitation to this method is that accumulated refrigerant gas in an enclosed area will also discolor the indicator and tend to mask actual location of the leak.

Halogen sensors spot smaller leaks

Leak detection in refrigeration cycles makes use of certain common properties of halogen family of refrigerants, such as the Freons. One instrument type exploits the halogen's ability to discolor gas flame while another type operates from the variation in electric emission caused by halogen.

Halide torch is sensitive enough to detect a leak as small as 10 oz per year. Torch assembly contains a shielded, replaceable copper reaction plate in the path of acetylene gas flame. A soft rubber detector tube attaches to the air intake and its free end is passed over suspected areas. If the tube passes over a halogen leak, inspirated fumes change flame color. Normally the flame is colorless, but 10 oz per year leak fringes it with green. With larger leaks, flame turns a solid bright green and finally to bright green fringed with red. Serious leaks snuff out the torch flame by cutting off its air supply.

When used in field tests, torch loses some sensitivity as a result of gas accumulations. Be careful when testing in confined and nonventilated areas. Fumes of most refrigerants burning in high-temperature flame are toxic. Modern adaptation of the torch measures flame change electronically, giving greater accuracy.

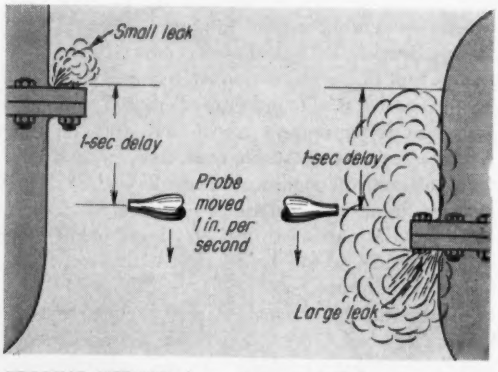
Leak detectors of the type shown on the preceding page are capable of spotting halogen leaks as small as 1/100 of an ounce of Refrigerant-12 per year, or 1×10^{-6} standard cc per second.

Halogen-sensitive element located in each detector unit consists of two heated, concentric, platinum cylinders. These cylinders show a large increase in positive-ion emission in the presence of a halogen vapor. This electric signal is fed to the control unit where it is amplified and used to indicate gas.

Automatic balancing circuit may be switched in for response only to sudden increases in the amount of tracer gas detected—such as when the probe passes near a leak. Under these circumstances the indicating instrument quickly returns to zero position after a leak has been detected and automatically maintains its zero setting even when there is a slow change in the background level of gas. This feature is helpful when testing where the atmosphere is contaminated with gas, or when detecting leaks in a vacuum system.

Some units are equipped with audible alarms triggered by halogen traces. Pitch of alarm varies with size of leak detected.

Normal test method for all the halogen-sensitive instruments is direct probing. Tip of the sampling tube is passed slowly along suspected areas. Recommended rate of probing varies with the length of sampling tube. For example: a 6-ft sampling tube introduces about 1-sec time delay between reaching a leak and receiving signal from analyzer, and a probing rate of one-in. per second is used. For a 15-ft sampling tube the delay would double and probing rate should drop to ½ in. per second. Illustration, below, shows effect of time delay on leak locating. Larger leaks flash their presence on first contact with gas envelope. With a variable-sensitivity instrument you can locate the actual point of the leak by probing from different directions.



PROBING METHOD detects increase in halogen concentration. Reducing sensitivity of circuit finds larger leaks

Latest refinements cut cost and weight for field testing

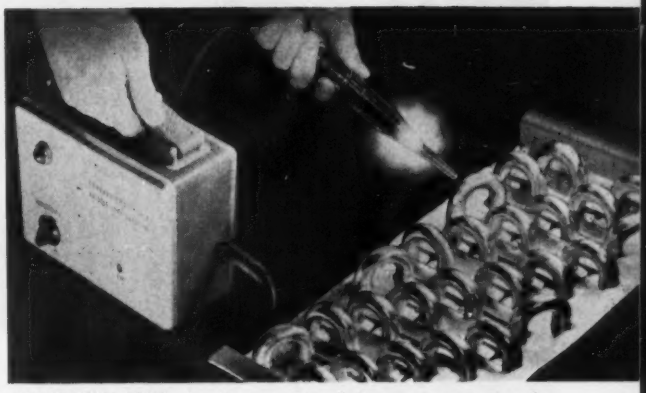
Latest addition to the family of halogen-sensitive leak detectors swaps some sensitivity for extreme portability and low cost. Unit, right, offers a sensitivity of ½ oz per year in an 8-lb package.

Probe assembly consists of a transparent plastic nozzle through which air sample is drawn. Inside probe a small lamp flashes when a leak is detected. Probe is connected to control unit by a flexible tube which carries lamp wires and small air-sample tube.

Control unit incorporates full-time automatic balance of zero. It does not give a quantitative indication of halogen concentration although a frequent user will be able to estimate values from the duration of the probe-light flash.

Background concentrations are balanced out up to 100 ppm. Beyond this point sensitivity of the basic instruments can be affected. One brand-new probe gets around this problem by mixing the gas sample with a fixed percentage of pure air. This proportioning action leans out background concentrations to the point where leaks down to ½ oz per year can be located in a background contamination of more than 1000 ppm.

Calibration of halogen-sensitive leak detectors requires a known sample for comparison. Standard calibrating units employed bottles of halogen-impregnated oil or precise mixing units which supplied any desired concentration of halogen (often Refrigerant-12). Newly developed calibrating unit, right, supplies an extremely precise reference which can be carried to test sites for final calibration. New unit makes possible accurate leak-rate determination by more sensitive halogen detectors.



HAND-HELD UNIT signals increasing halogen concentration by light flash in probe; 8-lb unit detects ½ oz per year leak

LEAK STANDARD supplies precise leak rate for calibration of detector under on-the-spot conditions of high halogen background

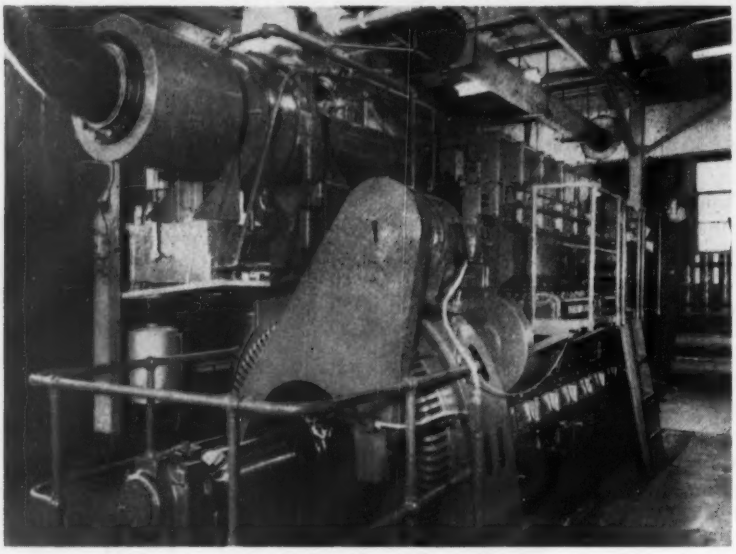
Mass spectrometer, isotope tracer handle critical measurements

Instruments in this category find use in any system or component under pressure or vacuum. They detect leaks which are too minute for the halogen detector; see service where an accurate measurement of the leak rate is required.

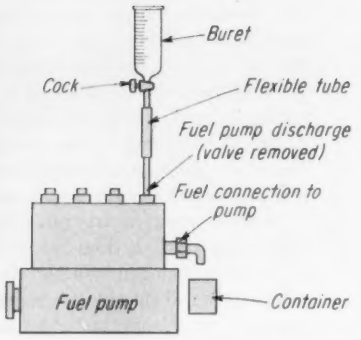
Ultrasensitive mass spectrometers quickly and accurately detect leaks as small as 1×10^{-10} cc of air per second. This would be equivalent to atmospheric air leaking into an evacuated vessel at a rate of one cc in 3000 years. As leak detectors mass spectrometers are usually designed to react to the presence of helium. Since helium is scarce, you would not use this unit where a halogen detector would suffice.

Gaseous-radioisotope tracers operate on the same basic sensitivity level. Test equipment and tracers are now available for specialized leak-detection work. Careful selection of tracer with correct half-life for your needs minimizes danger. For most leakage problems involving isotope tracers testing specialists should be called in to do the job.

MASS SPECTROMETER checks high vacuum container for leaks. Supersensitive instrument detects leaks of one cc in 3000 years



DROP TEST can often be made while the engine is running. Just cut off the delivery from each fuel pump in turn. Then carefully note the resulting drop in the engine speed



MOMENT OF INJECTION can be checked with this buret hooked up to fuel pump

Are you sure your diesel is timed correctly?

By P D HOBSON

Your diesel engine is in tune when (1) all mechanical parts operate smoothly with correct clearances and (2) each cylinder delivers same power with same efficiency.

To balance cylinder output you must achieve these conditions: (1) Make sure ignition takes place in each cylinder at same crank-angle degree before top center. (2) See that same quantity of fuel per stroke is burnt in each cylinder. (3) Check to see if exhaust gases leave each cylinder at same temperature. (4) Make sure peak firing pressure is same in each cylinder. If engine is good mechanically, and if any two of the above conditions prove OK, then the others are also all right. But if there is any doubt, check all four conditions. Example: if conditions (1) and (2) are obtained but compression pressure in one cylinder is low from stuck rings, leaky valves or a mismatched piston, then both maximum pressure and exhaust temperature will be low.

Injection timing and equalization of delivery. You can't control the moment of ignition in a diesel engine directly. But you can insure that fuel is injected into each cylinder at same degree before top center. If everything is mechanically right, including injectors, and injector release pressure is same for all cylinders, then ignition timing will also be the same. With duration of injection period the same for all pumps, quantity of fuel injected will also be the same, assuming that mechanical condition, plunger clearance, etc, is the same in all pumps.

To check moment of injection, many pumps have guide lines—but these aren't always reliable. Here's one reliable method you can use to check most modern pumps:

(1) Remove fuel line from pump to injector and fuel supply line to injection pump.

(2) Remove pump's discharge valve and replace discharge valve housing and connection.

(3) Connect a small glass buret to the pump's discharge connection. A short length of injector piping with a standard pump connection, with some plastic or oilproof rubber tubing, is usually best. Use a cock in buret to avoid wasting fuel, Fig. 1.

(4) In many injection pumps, delivery begins when plunger covers a port leading to fuel suction. Fuel will flow from buret back through pump to suction until this port is covered. So set pump at rack position corresponding to normal full-load operation. Then turn engine slowly in direction of rotation until fuel level in buret doesn't drop when cock is cracked open. Mark position of flywheel or note degrees before top center where this occurs. Continue turning engine in same direction with cock open until fuel again starts running out of buret. This point marks end of fuel delivery, due to either reopening a port connection to suction or to opening a spill valve. Error from time of travel of pressure pulse from fuel to injector is compensated by error resulting from the fact that a fuel pump usually starts delivery before the port is fully closed. That's why injection timing by this method is accurate enough in most stationary engines. *Always turn engine in direction of rotation or backlash in drive will cause serious errors.*

(5) Correct all pumps to same relative point of injection

by adjusting timing flanges of the drive or by adjusting the tappets of individual pump plungers. There is no tappet clearance in an injection pump. But lengthening tappet in the same way that would reduce clearance in a valve train will produce earlier injection, and vice versa. Where pump is in a separate casing bolted to camshaft housing, advance injection timing by removing shims between pump and camshaft housing and retard by adding shims. Where some injectors are farther from pump than others, pumps with the longer fuel lines may be corrected by advancing their timing about one degree per 14 to 18 in. of increased length. Corrected time of beginning injection should be same for each cylinder within ½ degree of crank angle.

(6) Correct all pumps to same injection duration. Do this in Bosch pumps by unclamping the toothed quadrant from plunger. Then rotate plunger to give correct injection duration without disturbing rack setting. Then reclamp quadrant. In spill-valve pumps, clearance between spill-valve stem and opening lever must be increased for increased delivery period, and vice versa. Duration of injection should be same for all cylinders within ½ crank-angle degree.

Here's a better way to check fuel pump delivery. Drive pump at normal operating speed with injectors removed from cylinders so it delivers into graduated vessels. Then check if delivery from various pumps is equal at equal rack setting. You can observe actual injection angle with a stroboscope.

Usually the delivery can be precisely balanced at only one rack setting. That's why you should set pump's fuel rack to correspond to normal full-load operation. In most pumps variation of fuel delivery period has no effect on the beginning of injection. Where this isn't true carry out Step (6) before Step (5).

In many small high-speed engines this is all you can do, but in most larger engines you can check either the exhaust temperature or maximum firing pressure. Many engineers tune an engine's exhaust temperatures only, but this can be very misleading.

All pumps may be delivering an equal quantity of fuel. But one may inject a few degrees earlier than others, giving that cylinder a lower exhaust temperature. If you increase fuel delivery to equalize exhaust temperatures, load on that cylinder will increase. Then maximum pressure may rise to a dangerously high level. In another engine the same variation in injection timing might cause a rise in exhaust temperature.

Exhaust temperature. Only practical method of checking exhaust temperatures is with a thermocouple. The iron-constantin or iron-nickel type is best—it's more resistant to high temperature than iron-copper and somewhat more resistant to corrosion. For permanence, fit thermocouples to project into gas stream, close to each individual exhaust port. Thermocouple doesn't measure gas temperature exactly, but gives an intermediate temperature dependent also on temperature of the manifold near the thermocouple. So each thermocouple must be in same position relative to each cylinder head. Also, insulation must be arranged the same way in each case.

You may use a galvanometer for each thermocouple, but a cheaper idea is to use a single galvanometer with a selector switch. Then you can connect each thermocouple in turn and use a portable surface temperature indicator. Place it against outer surface (bare metal) of each exhaust port connection in turn, at same relative position for each cylinder.

If pump timing has been equalized in advance, balance exhaust temperatures within 5% by adjusting the fuel-pump delivery. Set both timing and delivery as explained before. But when checking exhaust temperature you find an unbalance, check valve clearances and compression pressure. If these are correct, bring exhaust temperature into line by correcting fuel-pump delivery rather than timing. Reason: delivery is more likely to be off than timing if it has been set by "flow-through" method. This is true unless there's a big variation in distance between each pump and its injector. An error in delivery period is also less likely to cause damage from excessive peak pressures than is an error in beginning of fuel injection.

Peak-firing pressure. There are many instruments for finding peak-firing pressure. These fall into two main types. One is a pressure gage with a check valve. It's pumped up to peak pressure in the combustion chamber after a few strokes. The other type has a spring loaded piston in a cylinder connected to the combustion chamber. Spring load on piston is increased until piston ceases to move when cylinder fires. Either type gives you good results. To reduce errors, use identical type and size cock to connect the maximum-pressure indicator to each cylinder. Connect in same relative position. Equalize pressures within 5%.

You can't tune properly by adjusting peak pressures alone. It's possible to do so by balancing peak pressures and exhaust temperatures together. But this isn't easy since any change in fuel-pump timing or delivery will affect both together. So fix one fuel pump variable and adjust the other to equalize peak pressures. As in the case of exhaust temperature tuning, it's better to fix pump timing and adjust delivery. This holds true unless there's a wide variation in length of the line from pump to injector.

Drop test. You can often cut off delivery from each fuel pump in turn while engine is running. Note resulting drop in engine speed. Drop may be equalized by varying one fuel-pump constant (preferably delivery) as in case of exhaust temperature or peak pressure. If engine has a governor, lock it out of action or it'll adjust load on other cylinders to maintain a constant speed.

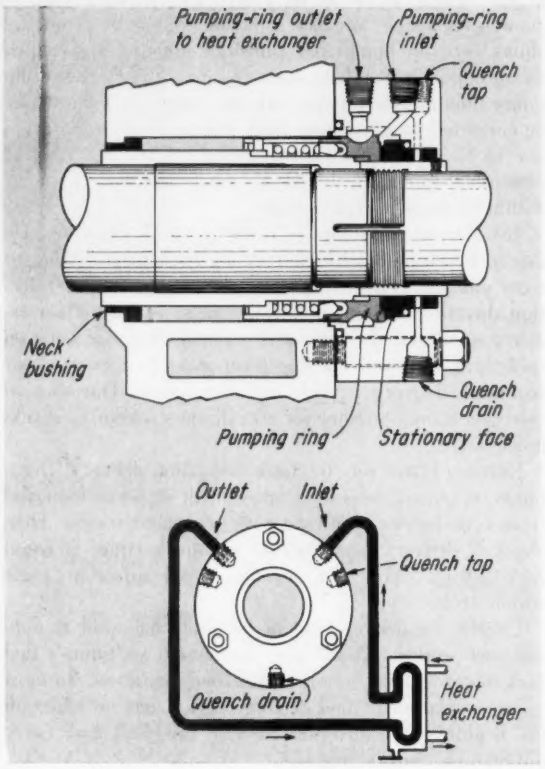
Where you can't cut out delivery of one pump with engine running, disconnect each injector in turn with engine stopped. Then start engine and run at a constant rack setting and note speed. It's almost impossible to have identical settings on each run, so I don't recommend this method. *Never* attempt to disconnect an injector with engine running. You can be seriously injured from high-pressure fuel jet striking your skin, even through clothing.

Summary. Usually best method of engine tuning is to (1) have engine in good mechanical condition and compression pressures equalized within 5% (2) set beginning of injection same for each cylinder (3) equalize exhaust temperatures or peak pressures by varying the individual fuel pump's delivery. Do this at normal operating load or as near it as possible. Remember, correct timing means good performance, low fuel consumption.

OPERATORS' NOTEBOOK 132

This mechanical seal

HERB TRACY holds pumping ring of mechanical seal used on feed pumps. Slots on ring's rim pump cooling water to the faces



SEAL ASSEMBLY and heat-exchanger hookup show how seal faces are cooled down to 180 F while sealing hot water at 550 F

Here's why you can seal high temperatures

Since my 24-page report, *Mechanical Seals*, first came out in March, 1954, I've tried to keep you readers informed of everything of interest in this field. I've sometimes been asked how a mechanical seal on a high-pressure feed pump can stand up. After all, pump is running at 3600 rpm and delivering water at 1000 psi and 550 F—that's pretty tough service. This is possibly the most critical application for mechanical seals: If a seal should fail suddenly, you have a real emergency on your hands. And on these h-p feed-pump applications, seal's rubbing surfaces are traveling at something like 135 feet per second.

To get the answer, I sat down with Herb Tracy, general manager of Borg-Warner Corp's Mechanical Seals Division in Los Angeles, on my recent trip to the coast. Herb's been designing and experimenting with mechanical seals for a long time.

"To lick the temperature problem," said Herb, "you must have water, not steam, leaking from the seal faces. That means that the faces must be cooled down to 180 F."

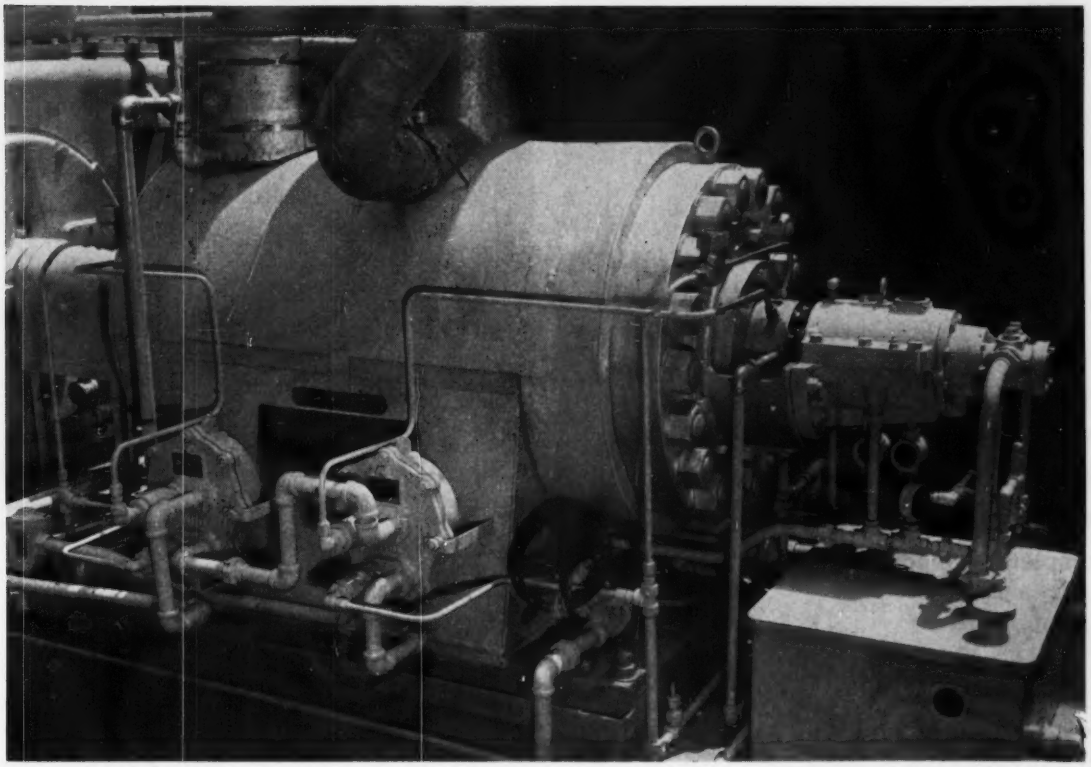
Of course you readers know that you have to have some fluid leakage across the seal faces for lubrication, although it may be minute. Often you can't see the leakage because it's so small and because the fluid evaporates as quickly as it leaks through.

Unique feature of seal shown here is the self-contained cooling system that reduces temperature at the seal faces without needing injection of cold condensate or makeup water. Rotating face has slots which act as a pump impeller or pumping ring. Seal flange has an outlet and inlet port. These ports are piped to a small heat exchanger to form a closed circulating system. During operation, water in the stuffing box is pumped through the heat exchanger. It's thus cooled before flowing back to the stuffing box adjacent to the seal contact surfaces.

Pumping ring takes suction at stuffing-box pressure and discharges to stuffing-box pressure. So head created by the pumping ring need only be high enough to overcome friction loss in the heat exchanger and piping. Throat bushing in bottom of stuffing box is most important. It prevents channeling of hot water from the main

is also a pump

STEVE ELONKA, Associate Editor



BARREL TYPE FEED PUMP has heat exchanger for each mechanical seal. Cooling water pumped through the heat exchangers is at 90 F, which is cool enough to keep the seal faces at the right temperature because there is so little leakage through the faces

and pressures

pump housing to the stuffing box. As a drop of cool water leaks across seal faces to atmosphere, an equal amount of hot water flows from main pump housing through bushing clearance into the stuffing box.

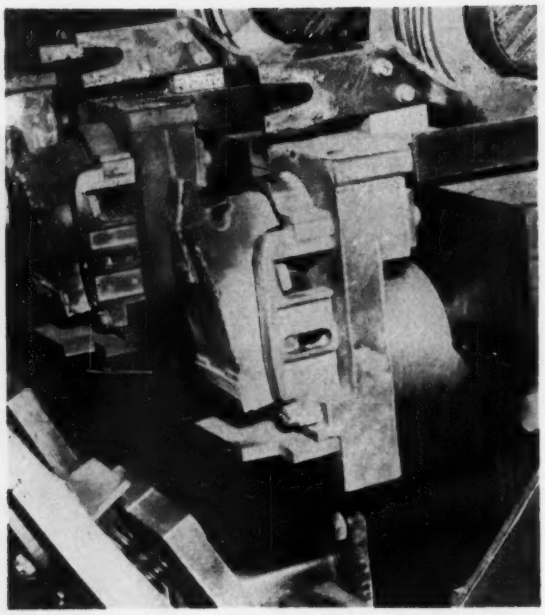
Because the bushing partially isolates stuffing box from the main pump, seal-cooling system must remove heat contained only in the minute quantity of water flowing through bushing clearance to replace seal leakage. But the cooling system must also remove heat transmitted to seal through the stuffing-box wall and shaft.

Capacity of the pumping ring and cooling area of the heat exchanger are designed for cooling water at 90 F flowing through the exchanger. Remember that when the main pump is idle, there's no flow through heat exchanger. Then you must provide cooling to reduce aging of gaskets and to assure that the seal faces will be lubricated with water instead of steam at startup. If pump has stuffing-box jackets, pipe cooling water to them. If there are no jackets, use mechanical seals with seal flanges provided with jackets for cooling. While cooling water to either the stuffing-box jacket or seal-flange jacket is needed only when pump is idle and up to temperature, you can allow cooling-water flow during running as well as idle periods to be sure you'll have cooling when you do need it.

Pumping ring on these seals requires an annular channel similar to a volute, plus a hole or port for discharge and a groove or slot for suction, drawing, above. The pumping ring uses very little energy. It must only overcome friction loss in piping and heat exchanger. And the heat exchanger for these mechanical seals is very small because it has little work to do.

How successful are seals on high-pressure feed pumps? Herb told me that one h-p boiler-feed pump equipped with these seals has been running for 26,500 hours, over three years, with no sign of needing maintenance. He also pointed out that since my special report came out in 1954, most of his company's barrel type feed pumps have been equipped with mechanical seals. Today, versatile mechanical seals are also used for sealing liquid oxygen at the extremely low temperature of −320 F.

By R C. DICKINSON and B I HAYFORD
Westinghouse Electric Corp



BREAKER CONTACTS become burned and pitted after numerous interruptions. Note arc splashes on surface adjacent to contacts

Magnetic air circuit breakers ordinarily need little cleaning and maintenance, but at least should get an "exercising" every six months, and complete inspection once a year

How much maintenance do today's magnetic air circuit breakers need?

Frequency of inspection of magnetic air circuit breakers depends on service conditions. Manufacturer's recommendations are intended for typical conditions. Very dirty or corrosive surroundings will step up the need for inspection, as will frequent operation. Time to start inspection is immediately after receiving breaker from the manufacturer, to see if damage has been done in shipment or if foreign matter has gotten into equipment.

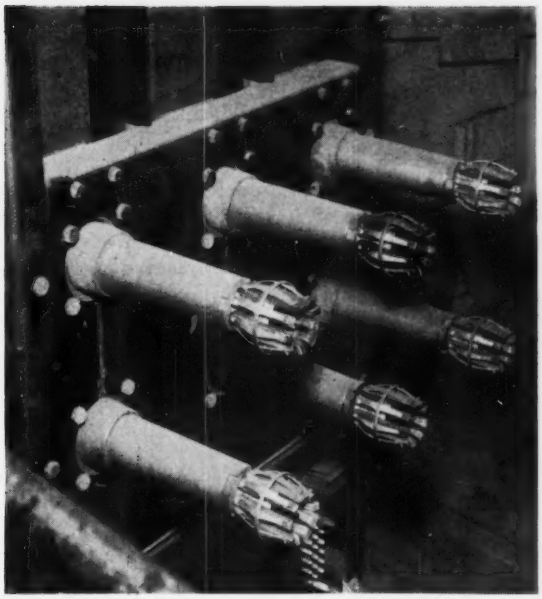
After installation but before energizing the main circuits, check each breaker for proper opening and closing both by hand and electrically. It is advisable to make an insulation check at this time as it is possible that stored equipment was exposed to excessive moisture. When you believe equipment has been dried out, proceed with a high-potential test of 75% of factory test, dc or rms-ac volts.

Inspection schedule will be developed by experience, starting with manufacturer's recommendations. Good general rule to begin with is to give feeder breakers in distribution service several "exercising" operations every six months and a complete inspection once a year.

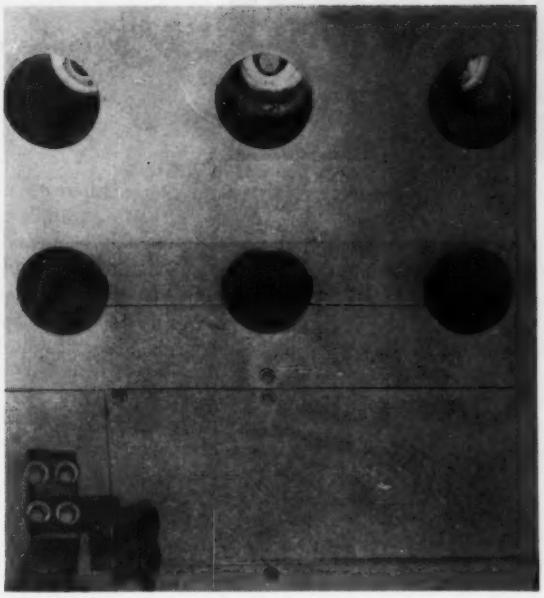
Circuit-breaker inspection and maintenance is principally concerned with (1) insulation (2) arc interrupters (3) contacts (4) mechanical operating parts and (5) auxiliary devices.

Insulation in magnetic air breakers and their metalclad equipment has been improved during the last few years. However, moisture in combination with dirt encountered in almost any locality results in leakage, no matter what the insulating material may be. In extreme cases flashover may result. Even porcelain will leak and flash over under some service conditions. In mild cases of leakage long exposure may develop permanent carbonized tracking in old types of organic insulation. Therefore, your best bet to protect insulation is: *keep it dry and keep it clean.*

Arc interrupters in modern magnetic air breakers expose only inorganic materials to the arc. No matter what material is used, however, the arc can melt or vaporize it with its extreme heat. Arc also melts and vaporizes metals of the contacts. These metallic vapors, with perhaps some of their oxides, condense on the insulating surfaces in the vicinity, including the inorganic materials. Deposits will also melt into surfaces of the inorganic materials. Result is



FINE DUST accumulates in some atmospheres. Coal dust, metallic and metallic-oxide particles may conduct if moisture appears



OUT-OF-THE-WAY PLACES like stationary contact supports may collect dirt over long periods, should be inspected regularly

that with repeated arc interruptions the insulation resistance of the arc chutes decreases, leakage increases, and if condition is carried to extreme the breaker fails to hold open-circuit voltage.

Clean flat surfaces in throat of arc chute. It's important to sand sooted organic materials of the arc-chamber enclosure to remove all traces of carbon or metallic deposit. Refinish, where advisable, according to manufacturer's instructions. You can most effectively clean surfaces of inorganic materials with a disk sander using a nonconducting abrasive. Test arc interrupters by applying at least 75% of factory test voltage to arc horns or runners. There may be special precautions to take, so check manufacturer's instructions.

Contacts in most magnetic air breakers include two types, *arcing* and *main*. If resistance of the main contacts becomes high, as it may from foreign material becoming embedded in the surfaces, from decrease in spring pressure or from excessive pitting, main contacts will overheat. This will also cause excessive current to be diverted through arcing contacts with consequent overheating. So keep the main contacts clean, smooth and in good alignment and keep pressure up to normal as indicated by contact-spring deflection.

Arcing contacts must make positive contact while they are touching or the main contacts may be badly burned when interrupting heavy faults. Failure to interrupt may result. Arcing contacts are expendable; don't allow contact material to be burned away so that a few more interruptions will burn through arcing tips and into the base metal.

Mechanical operating parts open and close the contacts in conjunction with power operating devices. Usually a solenoid (sometimes a motor which preloads a spring) is used for closing. One or more small solenoids or other types of electromagnets are used for tripping. Tripping is usually mechanically independent of the closing solenoid so that breaker contacts will open even though closing device is still in closing position. This combination is called a *mechanically trip-free* mechanism.

See that parts operate freely when tried by hand and electrically. Don't allow dirt or other foreign matter to accumulate around pins, in bearings, latches or other movable parts. Keep your eyes open for signs of wear. Wear usually results in loss of travel of the contacts and either too hard or too easy operation of latches: latches may stick or they may slip off and prematurely trip the breaker. Adjustments are provided for wear in certain parts. In other parts replacement is the remedy.

Stationary switchgear structure maintenance consists almost entirely of cleanliness. Since there are relatively few moving parts associated with the switchgear other than circuit breaker and its operating mechanism, wear is almost negligible. Check control relays and control switches periodically. Load protective relays to check for actual operation and time settings on a regular schedule. This will insure that they will function when called upon, and that the time setting is correct to coordinate with other relays in the electrical-distribution system.

Bus supports and bus insulation must be kept clean and dry. All bus supports, control wiring, instrument transformer mountings and other devices should be inspected for tightness at regularly scheduled intervals.

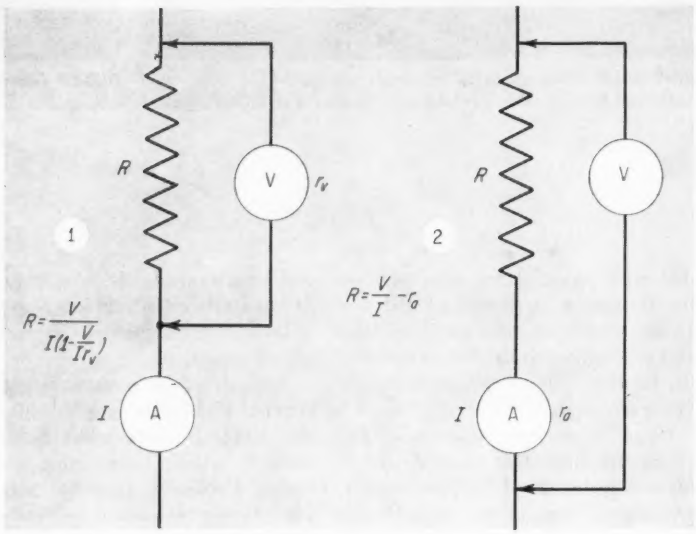
Plant Electrical Fact File

5 ways to measure resistance

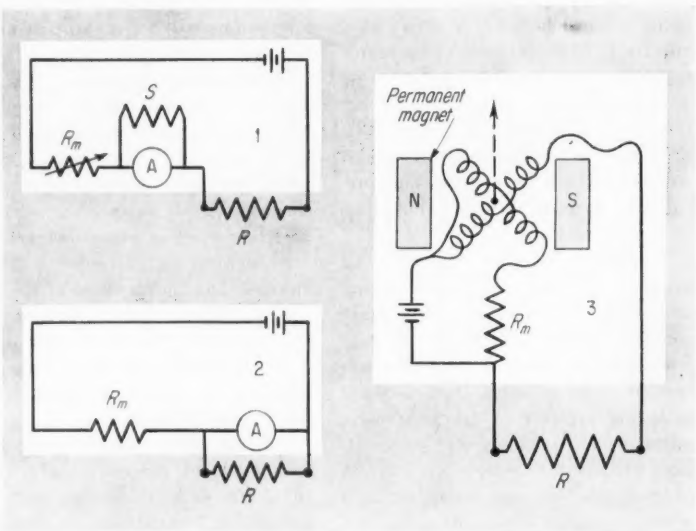
NO. 40: RESISTANCE

There are many ways by which you can measure resistance, depending on magnitude of the resistance, degree of accuracy required and kinds of instruments available. Methods described here are relatively uncomplicated and should meet needs of resistance measurements in the plant. Simplest methods employ instrument readings. For greater accuracy, comparison with a standard resistance by means of a potentiometer or Wheatstone bridge is the method most generally employed.

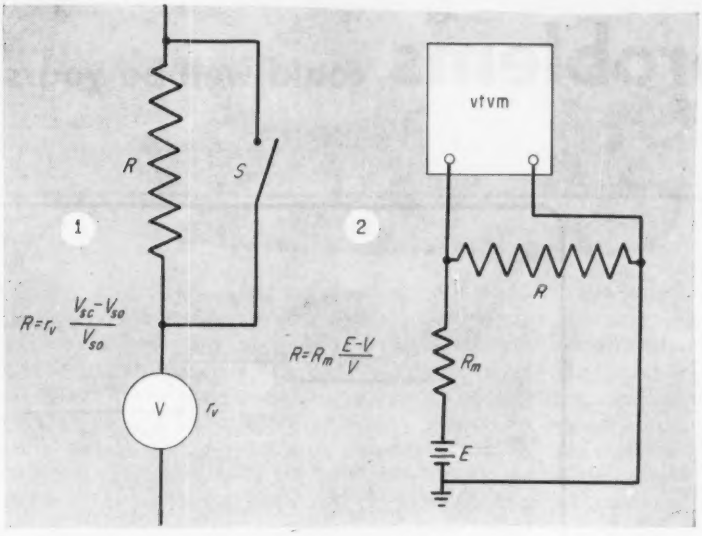
By NORMAN PEACH, Associate Editor



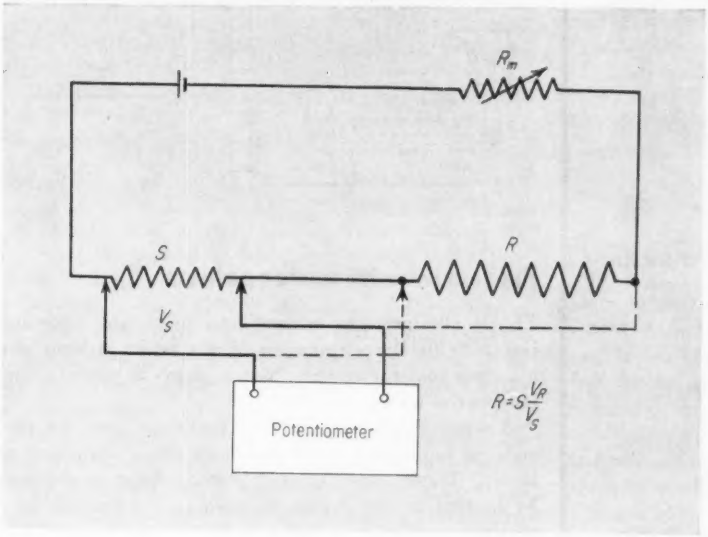
1 AMMETER - VOLTMETER method is handy where moderate accuracy is sufficient and resistance isn't extremely high or low. Allow for effect of the instruments; there are two possible hookups as shown at *1* and *2*. Accuracy of method depends mainly on accuracy of the instruments. Use a range which will give a fairly large deflection. For measurement of pure resistance use direct current and dc instruments. (Tips on hooking up were given in *Fact File No. 26*, June 1958)



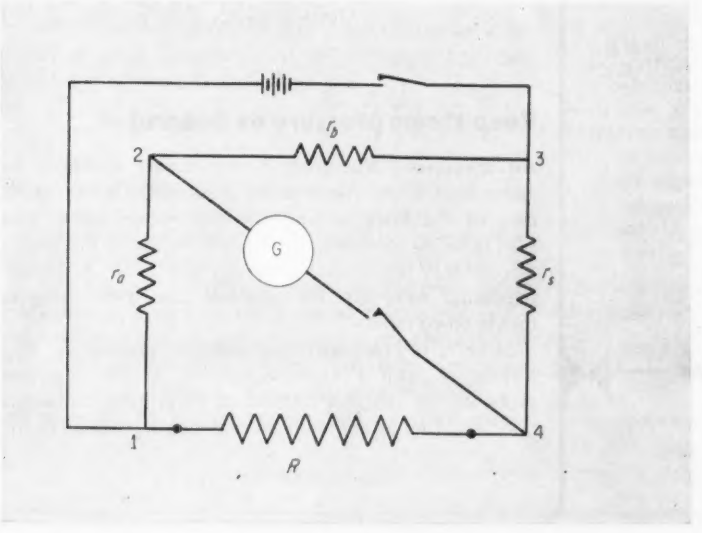
2 OHMMETERS are direct-reading instruments of moderate accuracy. You can get them in a wide range of resistance values. Simplest type, shown at *1*, has milliammeter to measure current through unknown resistor *R*; *S* is shunt to change instrument range. For low resistances, arrangement *2* may be used. Another type (basic insulation tester) has two separate moving coils on same shaft. Torque of one coil is proportional to current, the other to voltage across *R*. This type is generally for measuring high resistance



3 **DC VOLTMETERS** can be used to measure resistance. Permanent-magnet moving-coil (D'Arsonval) voltmeters can be used to measure moderately high resistances, *1*, by taking two readings: one with the voltmeter directly across the line V_{sc} and another with the unknown resistance in series, V_{so}. Vacuum-tube voltmeters, *2*, can be used over a wide range of unknown resistances, R. Known resistance R_m is selected for different ranges

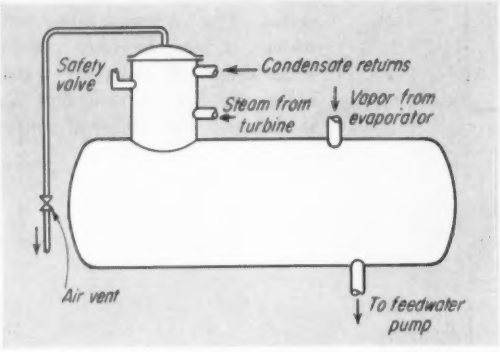


4 **POTENTIOMETER** method will give high accuracy if you have a good potentiometer available. Connect the unknown resistance R in series with a standard resistor S and a variable resistor R_m which regulates the battery current. Current in R and in potentiometer must be held constant. Resistance can be found from ratio of voltage drops V_R and V_S, each measured in turn. This method is suited to measuring resistance connected into networks



5 **WHEATSTONE BRIDGE** is available in several forms. It is widely used for cable-fault location (see *Fact File No. 12*, March 1957). Unknown resistance R is connected into the bridge and other resistances are adjusted until bridge is balanced (zero galvanometer reading). Voltage drop from *1* to *2* must equal drop from *1* to *4*, and the proportion $r_a/r_b = R/r_s$ holds, *or* $R = r_a r_s/r_b$. Battery is usual current source

These **plant problems** could well be yours...

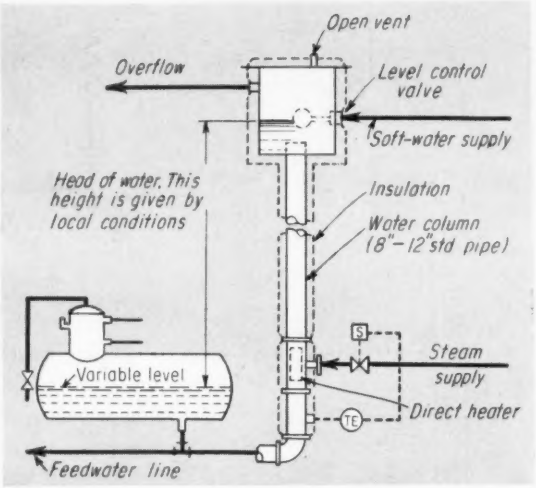


The problem

How can we keep air out of our deaerator during shutdown?

Addition of efficient new generating stations to the system has relegated one of our older power-generating units to the role of peaking operation only. This old-timer ran smoothly for twenty years. Now many problems arise when we run it as a peaking unit. Oxygen content of the feedwater climbs to 0.5 ppm when the unit starts up, then drops gradually to about 0.07 ppm after four or five hours' operation. When the unit operated continuously oxygen content ranged from 0.02 to 0.04 ppm. Apparently air leaks into the deaerating feedwater heater during shutdown. We are looking for a simple, inexpensive way of keeping air out of this tank. Operating temperature is normally 220 F. What do readers suggest?—*YL, June* POWER

The solutions



Pressurize with water column

YL can eliminate any contact between air and feedwater just with the transformation of his return system into a system under pressure. Sketch shows a practical and inexpensive way.

A water column is added to feedwater line; the pipe ends on top with a small tank with usual equipment as shown. Water added through water column is degassed by heating to the boiling temperature. Automatic temperature regulation is accomplished by thermostat (TE) actuating steam supply valve (S).

JOHN BORESTA, *West Englewood, N. J.*

Keep steam pressure on deaerator

Air leaks into deaerating heater during shutdown because heat losses cause steam present in heater at the time of shutdown to condense and reduce heater pressure to below atmospheric. If water is left in the deaerator, it will immediately absorb air until it reaches maximum solubility for whatever the water temperature happens to be.

Since it is practically impossible to prevent air from leaking in with a vacuum existing in the deaerator, probably the simplest method of preventing contamination would be to maintain normal steam pressure during

...Here's how Power readers would tackle them

LAWSON STEWART, Assistant Editor

shutdown. This could be dead-end pressure, but it would be preferable to adjust the vent to discharge a few pounds per hour. A larger amount could be run through and piped to a heat exchanger or other low-pressure steam load. There will be some temperature depression of storage water and possibly some very slight increase in oxygen content but far less than is presently occurring.

Another possibility would be to drain deaerator at shutdown. At startup, steam should be admitted first and allowed to blow through startup vent valve for ten or fifteen minutes. New water entering will be properly deaerated. Heat loss with this method could well be greater than the first suggestion, depending on frequency of shutdowns.

HARLAN J ANDERSEN, *Chicago, Ill.*

Install recirculating line

You may be able to recirculate feedwater through the deaerator. By regulating feed-pump control and adjusting valves on the recirculating lines, a steady flow rate can be established. This will keep water in the deaerator near saturated-steam temperature and should prevent oxygen absorption by the large volume of water in deaerator storage tank while deaerator is idle and water tends to cool down.

Pressure-reducing valve can float on the turbine exhaust line to balance out low-pressure steam requirements. However, even if you have more exhaust steam than deaerator can use, waste of steam through pressure-relief valve will be a small price to pay for keeping water up to near-saturation temperature.

I would recommend sizing recirculating line at 25% of normal pump output. Then recirculating flow rate can be throttled down as desired.

GIL CONNELL, *Berkley, Mich.*

You must degas stored water

Poor deaeration on short-term operation is common with some deaerators. Large volume of water gets cold and reabsorbs oxygen. On startup, steam enters above stored water which is heated largely by dilution with hot water. Stored water is not agitated, so there is no shake-out of oxygen and reduction in oxygen content to saturation level cannot be expected. Also, restricted vent can't release more oxygen than is brought in by makeup water.

Best cure is to convert to temperature-controlled setup. This unit heats stored water and agitates it, and an unrestricted vent releases oxygen from the tank.

Substantial improvement in deaeration can be had by turning on steam long before the boiler is fed. A circulating pump should route water through the steam and trays to heat stored water, agitate it for oxygen shake-out and expose oxygen to the vent. Vent should be opened up beyond opening required for continuous service. Don't worry about loss of thermal efficiency for the short time peaking unit is in service. Restricted-vent deaerators must lose either thermal efficiency or deaerating efficiency when loads are not constant.

Peaking units are exposed to tough service, so don't fail to provide good deaeration for this boiler. Either use a factory-built conversion or work out a circulating system of your own.

D R HETTELSATER, *Cheswick, Pa.*

Check vent-line restriction

Deaerator operation depends upon the fact that solubility of oxygen in water is zero when total pressure within vessel is equal to vapor pressure of water—in other words, when boiling point of the water is reached. However, insoluble oxygen gas molecules will remain in water mass by adhesion unless mechanical separation scrubs heated condensate. Normally this is accomplished by internal sprays and baffle trays. Generally speaking temperature of feedwater leaving deaerator should approach saturation temperature of steam at the inlet. Check steam pressure entering deaerator and refer to steam tables for equivalent saturation temperature, since some superheat may be present where extraction steam is used.

Unless the holdup capacity of *YL's* deaerator is quite large, four or five hours' operation to reduce oxygen concentration seems abnormally high. This would indicate trouble elsewhere, such as:

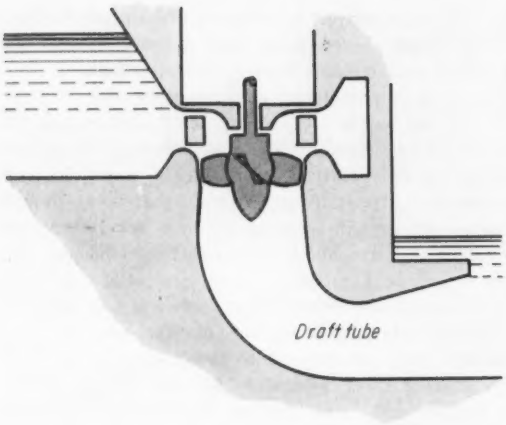
(1) Is vent line restricted? Open vent valve wide when starting, and then leave it 'cracked' so a wisp of steam can be seen.

(2) Is vent condenser leaking internally? This would allow condensate to by-pass the spray valves and scrubbing baffles without being deaerated.

P HAHN, *Norristown, Pa.*

Turn page for new problems ►

More **plant problems**



The problem

What's the best way to remove fresh-water barnacles?

A serious problem has come up in the operation of our hydroelectric plant. Recent inspection discloses the presence of fresh-water "barnacles" on every piece of steel and iron on the draft tubes and stop-log guides to the intake structure and spillway. The inspection engineer stated that in his many years of experience he has seldom seen a condition as serious as it is here. We want to remove these obstructions and take proper measures to hold any future incrustation to a minimum. Any suggestions or references which readers can offer will be appreciated.—*ACK, June* POWER

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

The solutions

Introduce chlorination program

Type and quantity of marine growth is influenced by chemical constituents and oxygen content of water, as well as its temperature. Some marine organisms manufacture their food with the aid of sunlight. Others depend on organic matter present in the water.

Many types of barnacles, mussels and other species of marine life have increased growth and reproductiveness during periods of mild water temperature. Chemical treatment with chlorine is frequently more effective during these periods. Injecting warm water into the main stream is one way of advancing the reproduction season, thereby making more troublesome species vulnerable to the toxic effects of chlorination.

Physical design and dimensions of the hydraulic circuit also influence effects of marine-life control. Varying velocity of water passing through draft tubes may cause channeling, stratification or both, retarding chemical control. This is a common problem for installations having large load variations which influence water flow and resulting velocities.

A "shock treatment" using chlorine injection has proved an effective and economical method for controlling marine life. With this procedure, chlorine is injected intermittently into water at or near the stop logs. Quantity and frequency of dosage is dictated by type of marine growth, water quantity and temperature. Presence of oxidizable material such as organic matter as well as hydrogen sulfide and ferric iron means you'll need more.

I recommend a chemical analysis of the water be made and temperatures be recorded. From this information a chlorinating program may be established which will control barnacle growth. Flexibility of modern chlorinating equipment permits varying dosage quantity and frequency to satisfy changing demand resulting from temperature and water-analysis variations.

H B WAYNE, *Woodhaven, N. Y.*

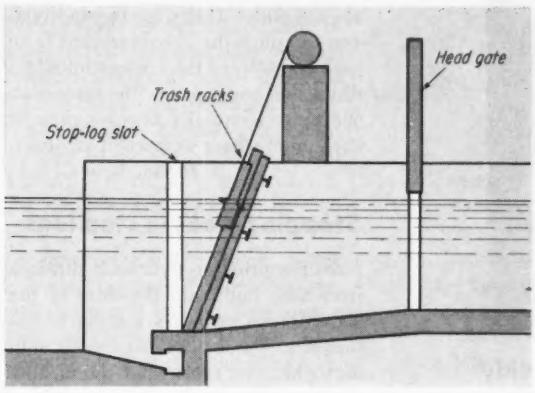
Use antifouling paint

Barnacles can be kept off underwater steel structures by applying a coat of antifouling paint over ordinary anticorrosion primer. Antifouling paints consist of poisonous ingredients such as cuprous oxide which are toxic to barnacles and other marine organisms. Paints are widely used to coat the bottom of steel ships. They are also applied to the interior surface of penstocks and draft tubes of hydroelectric plants where incrustation occurs.

If the plant cannot shut down to paint for a long time

to come, chlorine may be injected into water to poison the barnacles. Some steam power plants successfully eliminated problem of shellfish in cooling-water pipes by heavy dosage of chlorine for ten to fifteen minutes once every four or five days.

Y LEE, *Formosa, China*



Clean, treat water for lasting cure

ACK should still investigate the added protection of water ing present fouling and preventing future accumulations. From the inspecting engineer's description I assume a fairly extensive cleanup program will be needed. This would include mechanical cleaning of most of the encrusted area. In turn, mechanical cleaning plus damage caused by barnacles will probably force repainting of affected areas.

If this steelwork was not coated with antifouling paint to begin with it should be this time. Entire cleaning and repainting operation should be turned over to specialists. They will have equipment needed to do a fast, thorough cleaning job and will be able to recommend the proper antifouling paint for your specific conditions.

After repairing and protecting with antifouling paint, *ACK* should still investigate the added protection of water treatment. This usually takes the form of periodic chlorine doses injected into the stream ahead of log stops. Quantity and frequency of dosing depends on local conditions. Water analysis, water velocity, water temperature and types of marine life all affect treatment plans. This again is an area where the consulting specialist should be called upon.

E E ARCHBOLD, *Bedford, N. Y.*

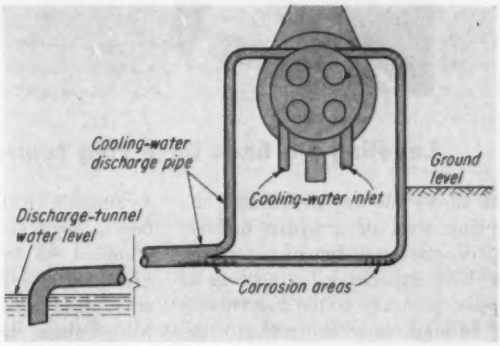
Your September problems

How can we clean our air lines?

We are faced with the problem of cleaning plant compressed-air lines and would like to know the best way to remove scale, oil, etc from system. Operating pressures are medium (230-1000 psig) and high (1000-3500 psig).

Someone suggested pumping caustic solution of 1-lb lye per 18-lb cold water through the system at 10 gpm for 10 minutes, flushing lines with 1-lb soda per 10-lb cold water for 20 minutes and drying lines by blowing air through them.

We would like to hear from POWER readers on this or any other method of cleaning.—*JOD*



What's best way to repair condenser cooling-water discharge pipe?

Vacuum on one of our condensers has dropped gradually to 26.5-in. Hg. A check of our records indicates cooling-water flow is now 65% of its original quantity. We found trouble was due to corrosion of cooling-water discharge pipe. Air leaked in, broke the siphon and reduced water flow rate.

Pipe was fabricated of ¼-in. mild steel plate, asphalt coated inside and out. Unit operates with sea water for condenser cooling. Most corroded portion lies about seven ft below ground level and five ft above sea level.

We have several questions to ask POWER readers. Why does the pipe corrode? What is the best way to repair it? How can we prevent the same thing from happening in the future?—*YL*

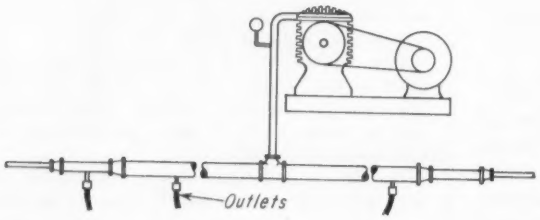
Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve

Leveling rig finds base ring faults quickly

Photo shows one way of checking the base-ring level of a hydro turbine. Surprisingly, a number of power stations have experienced a settling of turbines, generally on the downstream side. In some cases "concrete growth" and building shift have contributed towards putting machines out of alignment.

We installed a leveling plate with a suitable fitting and bearing to take a swinging. Then a good level mounted on top of a straightedge gives us an ideal way to check the amount of settling or malalignment with feelers. In the photo, the mechanic has marked off a dip of 0.040 in. While this is small, it's enough to call for a leveling up by grinding. L McWILLIAMS, *Shawingigan S, Que.*



Why not a tankless compressed-air system?

We just installed a unique compressed-air system in our small shop. As sketch shows, we left out the storage tank. Usual arrangement is to set up a compressor and a tank, then pipe air out from the tank. But in such a system piping must be large enough to keep pressure drop to a reasonable amount. And for good measure it's usually made still larger to take care of friction from future rust, etc.

We eliminated the tank but used larger piping. This serves for the tank as well as the distribution line. We figured it would cost less than a receiver and give us full line pressure at each outlet. If dry air is important, you can pitch the line downward from each end toward the center and add a drain line and valve to the low point. We tapped into the heavy piping at each point where we needed an outlet.

E JONES, *Bronx, N.Y.*

Stopping leaks in stop logs

Most low-pressure hydraulic turbines have slots built into the sides of the water-intake gateways leading to the turbines. These are designed for stop logs when you must enter the turbine case for inspection or repair work.

Usually they are rough sawed timbers, and don't fit too tight. They slide down into the slots in the sides of the waterway leading from the forebay to the turbine, and leak when the attempt is made to unwater the turbine case inside. Since the case must be at least partially dry to permit the work to go on, a problem exists that needs quick attention.

The old-timer merely hunts up the nearest cinder dump — usually the plant has a steam standby unit for emergencies—and comes back with a supply of mixed cinders and ashes which he dumps slowly down the upstream side of the stop logs. The mixture flows into the leak and usually plugs it.

Neither clear fine ashes nor heavy cinders are likely to be effective when applied alone. But when applied as a mixture, the larger particles are drawn into the opening first and serve as a stop for the finer ones which might be washed clear through the opening. Both sizes of cinders and ashes work together to close a bad leak. H B McDERMID, *Long Beach, Calif.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

All is not blister that bulges

Relieving the day-shift engineer in a paper mill, I found the recovery boiler in a process of slow shutdown. Oil guns were burning up the black-liquor "bed". I located the day-shift engineer, plant engineer and two visiting engineers on the fifth grating of the recovery boiler and they told me the boiler was going down due to a very bad bulge on a furnace tube.

They pointed out the location of the bulge from the fifth floor. But as I walked over to lift a lance port to get a better look at the bulge they all hollered, "Keep away!" We left the area quickly. Plant engineer wired the boiler company to send a mechanic to inspect and see how long it would take to replace the tube.

Shortly after that I went back to the fifth floor by myself and lifted the lance port to have a look at the so-called blister. I couldn't see how a 3-in. tube could bulge as much as the blister indicated without rupturing. Not with 200 psi in the tube.

So I took a steel lance, inserted it in the port—and knocked the "blister" off. This could have been unsafe, but I didn't think metal could expand that much without rupturing.

I went down to the chief's office and told him there was no more bulge. "What!" he hollered, thinking it had burst or something. "No", I said, "there never was a metal bulge, just a buildup of carryover that looked like a bulge."

So I started up the boiler and soon had it back on the line and on the liquor cycle.

W WAINIKKA, *Port Arthur, Canada*

Did you know . . .

that for the first time in McGraw-Hill history a library of two books has been published by the Book Co to standardize examinations for stationary engineers? It's written for those desiring to pass an examination and for the examiners preparing the tests.

What would you have done?

After World War II, I got a job as field construction boss for a boiler manufacturer. My first job took me to a small town to install two war-surplus watertube boilers. The boss gave me a dozen local laborers. Before long we had the frames up, the sections and the steam drums lined up and in place. Then a young stoker erector showed up.

He was just out of college and showed that he wasn't impressed with any of us. "Have you had experience in boiler work?" was his first question to me. "Yes," I answered, "about 12 years repairing boilers and about six years operating."

"Well," he boasted, "I just came from engineering school and I can do a lot with figures, but I may need your help on this practical stuff. There may be one or two things I don't know."

"Sure," I answered. "Glad to."

The following day one of my men accidentally dropped a hammer from the steam drum. It landed near the stoker erector. He went to the boss and said I had just tried to kill him. After that I clammed up, wouldn't give him the time of day.

Next day the bricklayer foreman showed up. He was a smart old guy and first calculated the distance he needed between his stoker side dumping grate and boiler plate to see if he had the needed space to place his walls. "Hell," he said, "we need two more inches of space. There's something wrong."

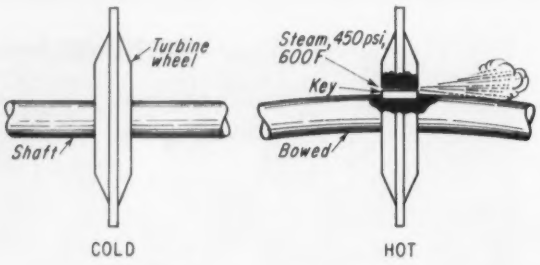
The boss turned to me, "How about it?" he asked. "I'm OK," I said. He then asked the young stoker erector. "I'm all right," he answered. The boss got mad. "Someone is wrong—now who the hell is it?"

I looked at the bricklayer boss and said, "You've got a square, plumb line and level, also the prints. Check it and tell us who's wrong." In about an hour he had the answer.

"The stoker is two inches too wide," he said. Well the stoker expert had come on the job with a diploma in his pocket and a sponge-rubber hat. For the next two days he sweated blood. Then he gave up and told the boss that he didn't know what was wrong. I felt sorry for him.

"OK," I said when he came to me. "You've neglected the small details. Any old erector would have noticed that the tuyere castings are rough and have projections when they come from the foundry. Chip and grind them down, then you'll have enough clearance so the castings won't stick and jam on the side walls when slag builds up." He did and his problem was solved. What would *you* have done?

E DUFF, *Aurora, Colorado*



Can this happen to your turbine?

Various expert vibration analyzers tried to balance a 15,000-kw steam turbine for several months. They used all the latest gadgets with no result. They finally condemned turbine shaft as defective and it was prepared for return to the factory.

But I began snooping around the turbine with an electric light on an extension cord. I noticed something unusual. I could see light coming through the keyway slot. Light dawned in my subconscious.

Cause of vibration appeared to be hot steam passing through the space between top of key and keyway slot. I deducted that the turbine was free from vibration until continuous passage of hot steam overheated the shaft. That caused a slight bow and a resulting unbalance, regardless of the balance weights.

Space was caulked with a soft steel to prevent steam leakage. When turbine was reassembled and balanced it ran in a well-balanced condition. Thus ended the mystery of vibration that couldn't be solved with gadgets because no one had used his head.

W R PENDER, *St. Petersburg, Fla.*

My favorite gripe

In the more than 50 years that recording instruments have been in service, uses have expanded until today there's little they cannot record or control.

Strangely though, the inking device of many meters is on a par with goose quills in comparison with modern pens. Most instrument pens still need daily inking. Various reservoir types either get plugged or provide too much ink that smears over other markings covering the chart with a blob of ink that stays wet for hours.

Surely a small ball-point pen could be adapted to recording instruments. Then any resulting inertia would tend to dampen out the oversensitivity that makes many charts unreadable.

For better all-around performance, even at the expense of extreme accuracy, why are multiple pens not given more clearance? Many of them foul each other, blurring the readings.

L HARRISON, *Vancouver, B.C.*

My biggest boner . . .

I made a voyage oiling an old triple-expansion engine. The other two oilers were brothers. After three months as shipmates, I considered them good men with the oil can. Both had third assistant engineer's licenses.

I always found everything shipshape when taking over the watch. Pretty soon I got lax due to the hot, humid tropical waters we were in. Then I skipped checking the shaft-alley bearings when I relieved a watch. I could check them on my 4:30-am round.

About 4:15 one morning I began to smell something odd. Looking over the plant I found the smell originated from the shaft alley. All twelve 18-in. babbit bearings were running hot. Each bearing had a block of grease and no oil flowing to the drip cans.

I fished the grease blocks out, as much as I could get. Then I took the oil-drip pipe off for cleaning. I flushed the bearings, made my regular rounds, and worked like hell the rest of my watch—also spent several extra hours cleaning up the mess, sweating and swearing all the time.

Each brother denied placing grease in the bearings. But the one who did had forgotten to take the heavy wrapping paper off. Moral of this story: even if it's Marmaduke you're relieving, check everything. Never assume the other guy is perfect.

TOM MULLIN, *Seattle, Wash.*

Soak that paper gasket

When a paper gasket is dried out from being stored, be sure to soak it in water. This makes the gasket flexible and prevents it from breaking or cracking when it's set in place.

M L MONSON, *Fosson, Minn.*

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PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

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PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

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Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

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4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, of cupro-nickel, as follows: (550) each ⅝" x 0.06e and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vent condenser — single pass — heating surface 174 sq. ft. — all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. *(2) High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F. *(2) Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

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A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Whse.	Sq. Cage	2300/440	1200
500	Allis Ch.	Slipring	2300/440	600
500	G.E.	Slipring	2300	900
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	400
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2300	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	G.E.	Sq. Cage	2200/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. TEFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
250	G.E.	Synch.	2300/440	360
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	0/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. (2)	Sq. Cage	2200/440	720
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Cr. Wh.	CCD	250	650
75	Gen. Elec.	CD-123	125/250	1200
75	Allis Ch. b.b.	EB-146L	125	1500
60	Ideal	D	125	1150
50	Whse.	SK-133	250	1750
40	Reliance b.b.	230-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	320/1000
150	G.E. b.b. dyn.	TLC-50	250	1750/3500
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
80	Whse. dyn. b.b.	SK-123L	250	1800/5000
75	Whse. (3)	SK-160	230	550/1150
60	G.E. TEFC b.b.	CD-135	230	1150
50	G.E. drip b.b.	CD-1445	230	300/1200
50	G.E.	RF-16	230	250/1000
30	Whse. b.b.	SK-133	230	400/1600
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
125	Whse.	220/440 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

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ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1776
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	850
1	300	G.E.	MTP-561	2300	1800
1	300	G.E.	MT-424Y	4000	257
1	250	G.E.	SIZE-290	2300	350
1	250	Cr. Wh.		550	600
1	250	A.C.		2200	435
1	250	Whse.	CW-1010	2200	580
1	200	G.E.	IM	2200	435
1	200	G.E.	IM	2200	1775
2	200	Whse.	CW-890	2300	

SQUIRREL CAGE

2	550	Whse.	CS-1115	2300	900
1	500	G.E.	FT-559AY	2300	3600
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Elliott	3910BB	2300	1200
2	400	Whse.	CS	6600/4000	3565
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-903H	2300	1175/878
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-855S	220/440	1750

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	3500	G.E.	TS-643SP	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	260	6600
1	500	G.E.	900	250	2300/4600
1	500	G.E.	900	125/250	440
1	350	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mhy.	1200	250	2300/4600

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	PYR.	1	55/255
2	500	Kuhl.	OISC	1	13200x6600
6	333	G.E.	OISC	1	7200/12470Yx2400/4160Y

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300

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1392 KVA Fairbanks Morse diesel engine generator unit 3 phase 60 cycle 2400 volts 300 RPM
Excellent condition

1250 KVA (2) Worthington supercharged diesel engine generator units 3 phase 60 cycle 2400/600/480 volts 360 RPM
New 1949 — Excellent condition

1050 KVA Nordberg supercharged diesel engine generator unit 3 phase 60 cycle 2400 volts 327 RPM
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The above units are still installed and can be adapted for Dual Fuel operation.

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1—6000 kva G.E. 3/66000/2400/4160Y
1—2000 kva Nia. Askarel, 3/13800/4160Y/2400
3—1000 kva Westinghouse, 1/22900/480
3—1000 kva Westinghouse, 1/13800/480
3—1000 kva Westinghouse, 1/13800/2400/4160Y
3—1000 kva Standard, 1/44000/6900
3—1000 kva Standard, 1/69000/4160Y/2400
3—1000 kva Standard, 1/34400/480

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4 horizontal, 10 vertical, Westinghouse Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
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1—Oil Circulating Pump Complete w/ motor
1—Oil Unloading Pump Complete w/motor
3—12,000 gallon Oil Storage Tanks
1—20,000 gallon Oil Storage Tanks

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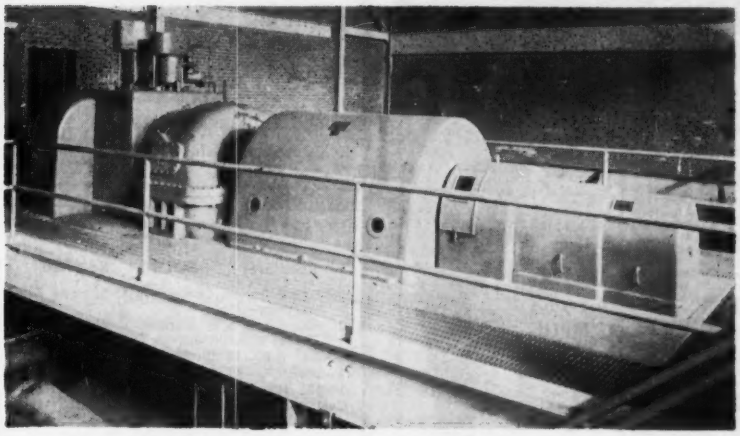

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New 1948 — Has operated
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1—7500 KW West. 400# 750° Cond. 4160V.
1—2500 Allis Chalmers 400 Aut. Ext. 150 N.C. 30# 480V.
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1—250, 4—150 & 2—100 KVA, 1/60/4160-120/240 Whse. Inerteen w/taps.
1—200 KVA Wag. 1/60/2300-115/230
3—100 KVA 1/60/4160-240/480 Packard OISC
3—25 KVA, WHSE. 1/60/2400—240/480 OISC.
2—50, 6—37½ KVA, G.E. 1/60/2400-120/240 OISC.

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4— 75 HP Cutler Hammer reduced voltage (wall mtg.)
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2—50 HP GE reversing (open panels)

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2—400 HP GE reduced voltage Synchronous, 2300 volt.
1—150 HP GE reduced voltage Synchronous, 440 volts.
2—150 HP Westinghouse reduced voltage (cubicles) 440 volts.
2—125 HP Westinghouse reduced voltage (cubicles) 440 volts.
7—Size 5 Across the line GE starters. 220/440.
1—Size 5 Across the line Sq. "D" starters. 220/440.

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10—Westinghouse 1200 ampere type DA-50 Air Circuit Breakers
25—Westinghouse molded case circuit breakers "K" frame.

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7—50 KVA GE 450 volt primary, 240/120 secondary.
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SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-83455	1200
500	*G.E.	K-83455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-359-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-509-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-349	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-930-A	900
200	G.E.	KT-564-S	720
200	*Al.-Ch.	AN-37-G	720
200	*West.	CS-1010	600
200	Al.-Ch.	ARW-681	600
150	Cr-Wh.	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	230
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Rdwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4160	125
125	G.E.	2300	250
100	G.E.	2300	250
100	Al. Ch.	2300	250
60	G.E.	220/440	250
40	G.E.	220/440	250

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3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200
1000	*West.	CW	430
600	*G.E.	M-8843-S	1800
500	G.E.	M-8845	1300
400	*G.E.	MTP-583	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh.	SR-70-R	1800
250	Al.-Ch.	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-18	850
200	*West.	CW1950A	514
150	Cr-Wh.	SR-50R	1800
150	G.E.	I-M-15A	1800
125	G.E.	I-M-15A	900
100	G.E.	I-E-13A	1800
100	G.E.	MT555	720
100	G.E.	I-M-13A	425
75	West.	CW-770	1200

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NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
500	L.A. B.B. Splash. 440 Volt	FX-1469	3600
500	G.E. S.B. Open	IK	1200
400	G.E. S.B. Open	IK-17B	900
400	L.A. B.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	CS	900
400	West. S.B. Splash 2800 Volt	CS-388	720
300	G.E. S.B. Open	IK	600
300	G.E. S.B. Open	IK	1800
300	G.E.S.B. Drip	K-559	1200
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1602	600
250	El. Dyn. T.E.F.C.B.B.	KNX	1800
250	G.E. S.B. Open	KT	1800
250	West B.B. Splash	CS-875	1800
250	G.E. S.B. Open 2200 Volt	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	West B.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15B	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	Al. Chal. B.B. Open		900
200	G.E. S.B. Open	IK	900
150	L.A. TEFCBB	JX-114	3600
150	West. S.S.B. Open	CS-761C	1800
150	Al. Chal. B.B. Open AR		1800
150	West. S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	IK	1800
150	G.E. B.B. Open	KT	1200
150	F.M. B.B. Open	H-24A	900
150	G.E. S.B. Open	IK	900
150	Cont T.E.F.C. B.B. New		900
150	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	Cont. TEFCBB XP	AP-100	1800
125	Burke B.B. Open 440 Volt	N-505	3600
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	West TEFCBBCS	855	1200
125	Al. Chal. B.B. Open AR		1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E.S.B. Open	K-546	1200
125	F.M. B.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
125	West B.B. Open CS-874C		600
100	Howell T.E.F.C.B.B.	K-505	3600
100	Cont. TEFCBB XP	AP-505	1800
100	West. T.E.F.C. B.B.	CS-753	1800
100	G.E. S.B. Open	KT-548	1800
100	G.E. B.B. Open	K-504	1800
100	LA. T.E.F.C.B.B.	JX-113	1800
100	West. TEFCBB	CS-770	1200
100	G.E. S.B. Open	KT-547	1200
100	West. SBB Open	CS-607	1200
100	F.M. B.B. Open	H20C	900
100	F.M. B.B. Open	H	720
100	F.M.B.B. Open	H	600
75	Reliance B.B. Splash	505	1200
75	Al. Chal. TEFCBB	ARZ	1200
75	G.E. B.B. Open	KT-547	1200

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1 Condensing Turbine — Westinghouse 1000 KW 3/60 2300V 3600 RPM 160 PSIG, complete with circulating pumps and auxiliaries.

1 Springfield, self-contained gas boiler unit, 2-drum water tubes 200# PSIG.

ANGELINA COUNTY LUMBER COMPANY
Jasper Division, Jasper, Texas

BOILERS

BOUGHT	SOLD	RENTED

2—50,000 lbs. hr. Combustion Engineering 250 lbs. press—1950
2—600 H.P. B & W Sectional Steel Headers—200 lb. press
1—300 H.P.—15 lb. press Superior Package
1—200 H.P.—15 lb. press Cyclotherm
1—125 H.P. Dowtherm — Cleaver — Brooks
Cyclotherms 15- 30- 50- 90- 125- 200 H.P.
Cleaver—Brooks—50- 70- 80 H.P.
Waste—Heat Boiler—200 H.P.—250 lbs.

BOILER & EQUIPMENT CO. INC.
743 BEDFORD AVE. BKLYN. 5, N. Y.
ULSTER 5-3588

1250 K.W. TURBO GENERATORS

NEW — UNUSED

Mfg. by Westinghouse

GENERATOR:

1250 K.W.—450 volts—3 phase—60 cycle—80% P.F.—1200 R.P.M. with 16 K.W. on a 120 volt D.C. exciter.

TURBINE

540 lbs. per sq. inch gauge with 825° T.T. and one lb. per sq. inch absolute exhaust pressure. It will develop rated capacity with steam conditions of 432 lbs. per sq. inch—825° T.T. and one lb. per sq. inch exhaust pressure. Turbine R.P.M. 8050. The turbine exhausts into an auxiliary condenser.

DIMENSIONS

16'4 5/16" long—60" wide

These units originally built for Battleship Kentucky to highest Naval standards using only prime materials.

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELIGIN 5-5050 — LEXINGTON 9-1900

MODERN GE RECTIFIERS

3/60/13,200 AC to 600V. DC

4—1000KW Mod. 6RC-45-CD6
2— 500KW Mod. 6RG-45-CH2

Six Tube Ignitron Pump Type

Full Automatic AC & DC Controls

Can be inspected on original locations new in 1948, still like new, actual photos are available, very low price for lot.

S. M. DAVIS
525 N. 20th, E. St. Louis, Ill.

BOILER FOR SALE

One B & W Integral Furnace FF-16 No. 48. Designed pressure 225 psi, oil, gas tar or natural gas fired, rated 45,000#/hr. at 135 psi. Complete accessories inclucing soot blowers, burners, fans, control panel, oil heaters, connecting valves, nozzle cleaning bench, etc. For additional information pertaining to detailed description, terms of sale and location call or write

LONG ISLAND LIGHTING COMPANY
175 Old Country Road, Hicksville, New York
Attention of Mr. S. L. Koslow

SEARCHLIGHT Equipment Locating SERVICE

No Cost or Obligation

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used power equipment not currently advertised. This service is for USER-BUYERS only. How to use: Check the dealer ads to see if what you want is currently advertised. If not, send us the specifications of the equipment and/or components wanted on the coupon below, or on your own company letterhead to:

SEARCHLIGHT EQUIPMENT LOCATING SERVICE
c/o POWER Classified Advertising
P.O. Box 12, New York 36, N. Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

SEARCHLIGHT EQUIPMENT LOCATING SERVICE,
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9/59

BOILERS

HI-PRESSURE

Complete Stock from 10-2,000 h.p.
Nation's largest inventory, New & Used

WABASH POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-8118

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BOILERS — GENERATORS

C. R. CAMPBELL & CO. LTD.
3077 Bathurst St., Toronto 19

POWER EQUIPMENT

BOILERS

3—1296 HP B&W Sectional Steel Headers 275 PSI Gas/Oil Fired

1—75000#/hr 650 PSI 650°F Oil Fired C.E.

1—25000#/hr 450 PSI 738°F Stirling Stoker

1—200 HP 160 PSI Keeler, Stoker Fired

12—NEW UNASSEMBLED B&W, F.W. C.E. with Superheater, Economizer, Soot Blowers, Oil Burners, Steel Encased—Rated:
122,500#/hr, 565 PSI, 850°F
44,500#/hr, 450 PSI, 735°F
35,000#/hr, 285 PSI, 577°F

GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear
(can be seen running)

2—60 KW G.M. Model 6-71 Diesel Sets 3/60/440 1200 RPM

1—1875 KVA Condensing 400 PSI 700°F with Surface Condenser 3/60/2300 Turbo Set

1—500 KW Condensing 200 PSI Turbine

1—500 KW G.E. Non Cond. 265 PSI, 0-10# BP Turbo Generator

TRANSFORMERS

2—1500 KVA 3 phase, 34,500-460 G.E.
1— 750 KVA 3/60/2400/4160 Y—480
3— 333 KVA 1/60/2400/4160 Y—480
3— 250 KVA 1/60/2400/4160 Y—480
3— 75 KVA 4600-115/230 Single phase
2— 50 KVA 440-120/240 Single phase

A. C. MOTORS — 3 ph. 60 Cy.

SQUIRREL CAGE 2300 Volt

Qu.	HP	Make	Type		Speed
2	2000	A.C.	ANW		1750
2	350	A.C.	AZZ	TEFC X.P.	3600
1	250	Cont.	NP	TEFC X.P.	720
1	200	G.E.	KF	TEFC X.P.	3600
2	150	G.E.	K	TEFC X.P.	900*
1	150	A.C.	AZZ	TEFC X.P.	3600
1	150	Cont.	PV	TEFC X.P.	1800
1	125	Cont.	NP	TEFC X.P.	3600
1	125	G.E.	KF	TEFC X.P.	1800
3	100	G.E.	K	TEFC X.P.	1800*
2	100	G.E.	KF	TEFC X.P.	1800*
1	100	A.C.	AZZ	TEFC X.P.	3600
1	50	G.E.	AZZ	TEFC X.P.	1800/900*

*440 Volt

SLIP RING 440 Volt

2	400	West.	CW	720
1	150	West.	CW	1800
3	75	West.	CW	1800
3	30	West.	CW	1200

HEAT & POWER CO. INC.

POWER EQUIP. DIV.

60 East 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

Power Plant Equipment

1—Elliott deaerating heater 220,000#s per hour.

3—Peabody wide range oil burners, 60,000#s steam per hour capacity complete with piping, valves and windbox.

3—Fireye Flame detectors with above burners.

1—Engineer Fuel Oil Pumping and Heating set.

2—Worthington feed water pumps, 466 GPM at 325#s driven by Moore 140 HP turbines.

1—500 KW Allis-Chalmer turbo-generator 3/60/480.

1—1000 HP B&W sect. header boiler, 225 psi.

MIDWEST BOILER & TURBINE CO.
520—5th Ave., New York 36, N. Y.

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2200/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl.-Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2200	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis.	OX	1200
100	2300	Cont'l.	TEFC	3600
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., Al. Chal., 15 KV, Outdoor
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	H/brg.	800
60/75	230	G.E. (new)	CD	500/1500
50/60	230	Rel.	T	600/1800
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input.. AC	Motor Type	Output V., DC
300	Whse.	4150/400	Syn.	250/125
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 12800—2300 V.
3—500 kva, G.E., 12800—240/480 V.
3—333 kva, American, 2400—240/120 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E. 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

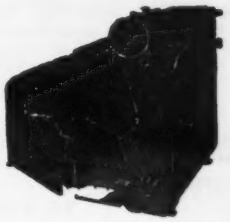
GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R. 220 V, 3 ph. con. LeRoi, 6 cyl.
only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

BOILERS

NEW UNASSEMBLED



# Steam hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.

315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE-2-4513

POWER EQUIPMENT

7500 KW West. Cond. Turbo-Gens. (2) 3 ph., 60 cy., 4160 V, 3600 RPM 400 PSI, 750°, D.C. exciter

1000 KW Worth-Moore Cond Ext Turbine 3/60 245/490V 130-300#IP,10#Ext

700 KW G.M. 12-567 Diesel Units (4) 3 ph., 60 cycle, 480/2400 V

150 KW General Motors Diesel Units 3/60 220/440V 1800 RPM - (3)

BREW, WOLTMAN & CO., INC.
50 Church Street, New York 7, N. Y.

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4800-120/240
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/2820Y/120/240
3	250	West.		1	2300/4600-230/460
3	200	G.E.	HSW2F	1	2400/4160-240/480
3	200	Al.-Ch.	CB	1	2400/4160-240/480
3	167	G.E.	H8	1	2400/4160-240/480
3	75	G.E.	KF	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1200

1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
1	75	G.E.	1180	MT-547	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9,	220 or 440
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M369Z	2300/4160Y

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	250	G.E.	1200	Pedestal
1	92	West.	425/1000	SK 113
1	30	G.E.	1750	173 FR
1	30	West.	690/1400	SK-401543

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1130 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3Ø 60-440V.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Fom BL 2200 V.
125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 3600 RPM G.E. type TS Fr. 956Y 2200 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

FOR POWER
J.L. HEMPHILL & CO.
4800 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK LONGACRE 5-3227
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Dismantling surplus facilities as a result of
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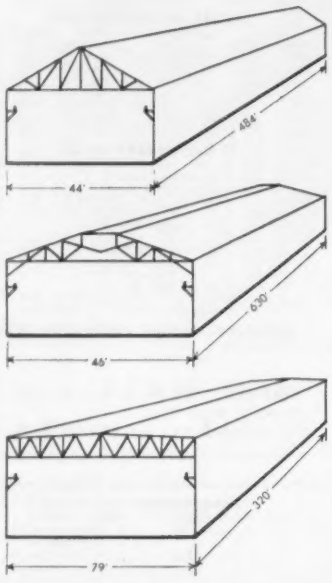
Modernization Program at Massena, N. Y.

21 Steel-Frame Heavy-Industrial BUILDINGS

IN EXCELLENT CONDITION

MUST BE SOLD AT ONCE

Various Sizes, Clear Spans, brick curtain-walls.
All with Overhead Cranes
Easily Dismantled
Ideal for Re-erection



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Including motors, generators, transformers, convertors, rectifiers, controls etc.

Rotary ball-mill, cement mixer batch plant, foundry items, gas producer machines, crushers, blowers, scales, heavy carts, crane boxes, bucket and belt conveyors, hydropneumatic accumulator, etc.

Structural steel shapes, pipe, valves, grating, overhead doors, steel & wood silos and numerous other items.

For complete information, prices and inspection arrangements contact

CUYAHOGA WRECKING CO.

SALES AND FIELD OFFICE
P. O. BOX 384 **MASSENA, N. Y.** **RO 4-0253**

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25 to 40 Ton Diesel Locomotive Cranes
50 Ton Diesel Electric Gantry
50 Ton Gantry Trucks
600 HP West. DC230V 150/190 RPM
1200 KW Allis Chal DC 525V 750 RPM
1250 HP FM Syn 3/60/13200V/720 RPM
1500 HP West Unused DC 525V 600 RPM
6000 HP GE 3/93 Cycles/2700V/400RPM
(4000HP/60 cycle/257RPM)

ALL SIZE ENGINES —
GENERATORS — CONTROLS, ETC.

ALBERT HELLER'S **SHIP SUPPLY CORP.**
87 Hamilton Ave., Brooklyn 31, N.Y.
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1902 COMPRESSORS 1959
WORLD'S BEST REBUILTS

100 CFM 125 psi 6x7 Ing. ESI
188 CFM 100 psi 7x7 Ing. ES-1
162 CFM 125-500 psi 7½x13 Worth HB
180 CFM 60 psi 8x7 Ing. ES
184 CFM 135 psi 8x9 Ing. ES
238 CFM 100 psi 9x9 Worth. H. B. Ing. ES
268 CFM 500 psi 10-4¼x10 Ing.
290 CFM 75 psi 10x9 Ing. ES-1
311 CFM 1500 psi 10½-7⅛-3½x13 Ing. ES3
321 CFM 125 psi 10x11 Ing ES
406 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x13 Worth HB
585 CFM 100 psi 15-9¼x12 Ing. XRE
628 CFM 100 psi 14x13 Ing ES
670 CFM 100 psi 15-9¼x12 Ing. XRB
1016 CFM 55 psi 17x13 Worth HB
1545 CFM 110 psi 21-13x14 Ing. XRE
7950 CFM 280 psi 33-17¾x27 IR PRE2 4C

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

BOILERS

2—250 Hp B&W Sect. Head.
4—500 Hp B&W Sect. Head.
3—600 Hp B&W Sect. Head.
2—750 Hp B&W Sect. Head.
2—1100 Hp B&W Sect. Head.
1—90000 Lbs/Hr B&W 450 Lb.
1—70000 Lbs/Hr B&W 300 Lb.

ARG CHEMICAL MACHINERY
507 FIFTH AVENUE
NEW YORK, N. Y.

BOILER
1—Keeler 200 HP, 160 psi, water-tube, w/acc.

COAL PULVERIZERS
1—Babcock & Wilcox #32E, 75 HP
1—Raymond 6-roll mill, 66" dia., 200 HP
3—Robinson #13 Sawtooth Crushers, 15 HP

COAL HANDLING CONVEYORS
4500'—16", & 24" all-steel trough rubber belt conveyor, complete units
150'-48" wide apron feeders

WRITE FOR DETAILS

PERRY EQUIPMENT CORP.
1422 N. 6th St., Philadelphia 22, Pa.
Phone: POplar 3-3505

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P.O. Box 12, New York 36, N.Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

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c/o Power,
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New York 36, N. Y.

Please help us to locate the following used equipment:

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STREET .....

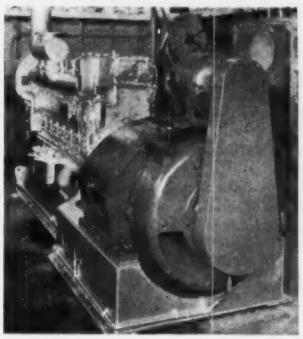
CITY .....

ZONE ..... STATE .....

9/59

Big Savings from Manufacturer's price

300KW GM DIESEL ENGINE GENERATOR SETS



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Any standard voltage.

Immediate delivery from stock.

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Cal. Edgewater 2-1490

50 Church St., New York 7, N. Y. Digby 9-4351

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION

909 National City East Sixth Building

Cleveland 14, Ohio

LIQUIDATION

5—B & W 70,000# per hour Boilers, 500 psi, (1952)
1—I. R. Two Stage Compresser, type HHE-2, 3170 cfm, 125 psi, 600 HP motor. (1955)
1—I. R. Turbo Exhauster 15,360 cfm at 4.86 psi driven by 454 HP Moore Steam Turbine 125# steam, 6100 rpm, with I. R. two stage Barometric Condenser.
1—I. R. Turbo Exhauster 17,000 cfm at 4.15 psi driven by 678 HP G.E. Steam Turbine 125# steam, 4600 rpm with I. R. two stage Barometric Condenser.
200—Centrifugal Pumps with explosion proof motors, up to 9000 gpm.

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BRILL EQUIPMENT COMPANY
2401 Third Ave., New York 51, N. Y.
Tel. CYpress 2-5703

1-Ace Uniflow size 18 oil burner complete with all controls.
1-Ace Uniflow size 20 oil burner complete with all controls.
1-Steam Preheater for same.

For information write

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AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design or Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

FOR SALE
IN OPERATING CONDITION

BOILERS

1—20,000#/Hr. Springfield Sectional Header St. Tube Cross Drum for 200# W.P. 100° S.H. with Detroit Dumping Grate Spreader Stoker and all auxiliaries.
2—30,000#/Hr. Babcock & Wilcox Sectional Header Straight Tube Longitudinal Drum for 200# W.P. 100° S.H. with Coppus Gas-Oil Burners and all auxiliaries.
1—60,000#/Hr. Springfield Sectional Header Straight Tube Cross Drum for 250# 100° S.H. with Firite Dumping Grate Spreader Stoker and all auxiliaries.
2—20,000#/Hr. Babcock & Wilcox Sectional Header Straight Tube Longitudinal Drums for 150# Saturated with Detroit Dumping Grate Spreader Stoker and all auxiliaries.
2—30,000#/Hr. Murray Bent Tube 3-Drum Sterling Type for 200# W.P. Saturated with Detroit Dumping Grate Spreader Stokers and all auxiliaries.

AIR COMPRESSORS

1—Steam Driven Ingersoll-Rand 1000 CFM @ 100# uses Steam 175#-500°-5#
1—Steam Driven Ingersoll-Rand XPV-700 CFM @ 100# uses Steam 150#-Sat-5#
1—75 HP Motor Driven Ingersoll-Rand Type 10-375 CFM @ 100#-440 volts-3 phase-60 cycle
1—42" x 12' Compressed Air Tank

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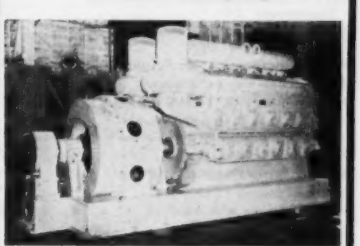

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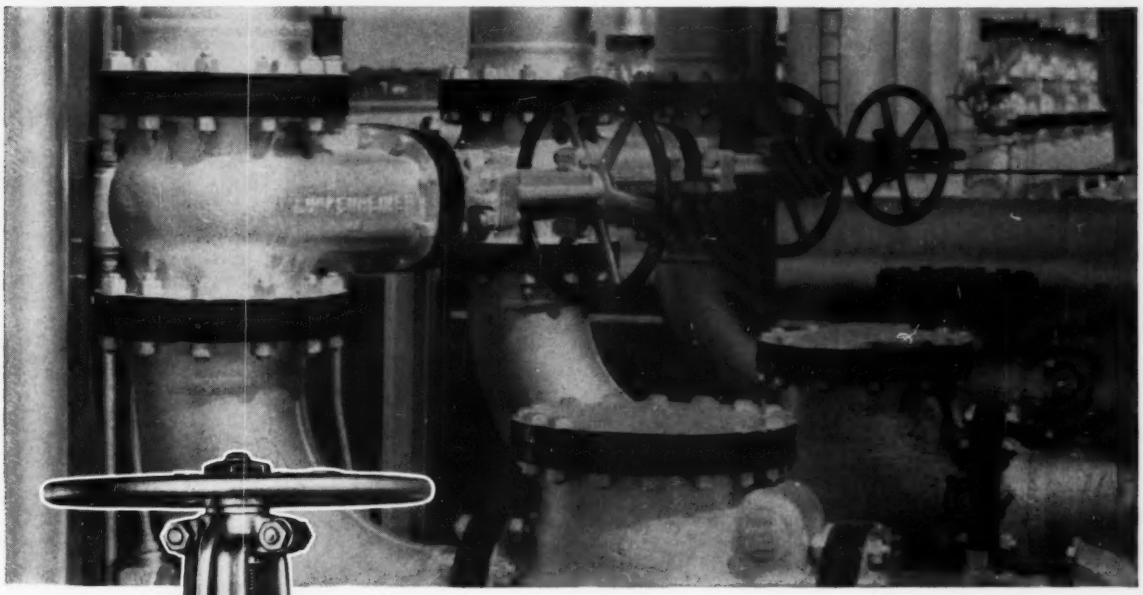

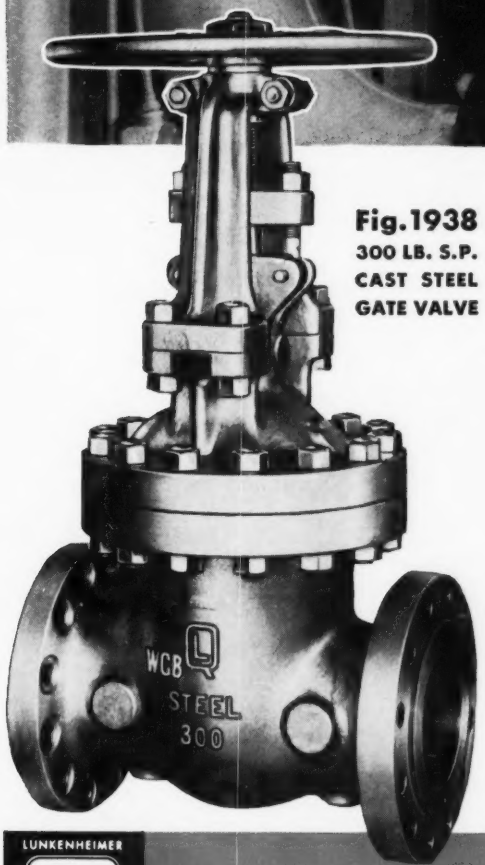

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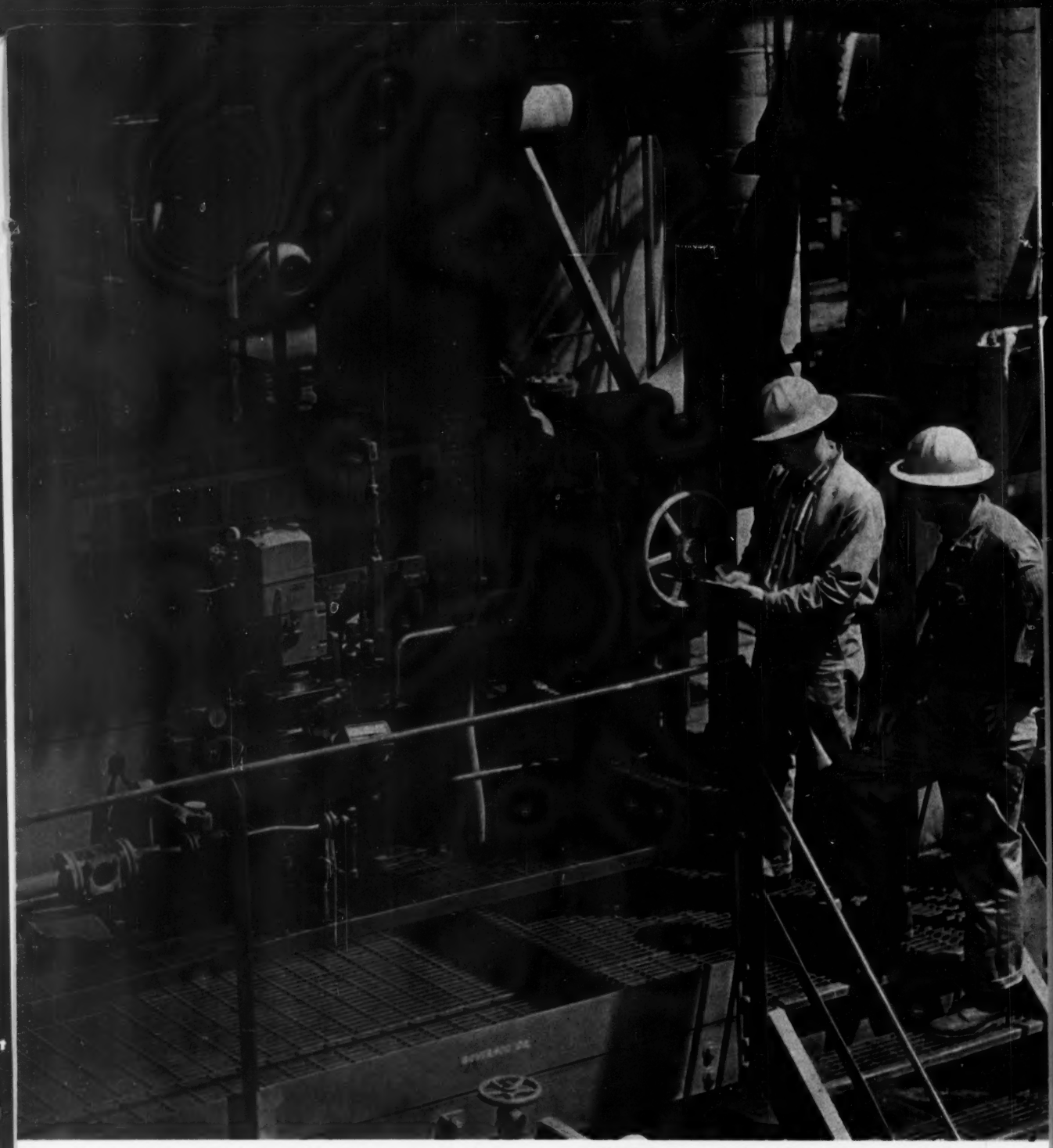

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